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(71)Applicant : IBIDEN CO LTD
(72)Inventor : ASAI MOTOO

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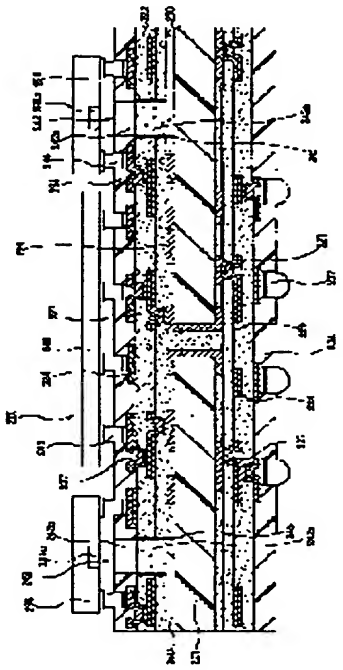
(54) IC CHIP MOUNTING SUBSTRATE AND METHOD FOR MANUFACTURING IC CHIP MOUNTING SUBSTRATE

(57)Abstract:
PROBLEM TO BE SOLVED: To provide an IC chip mounting substrate in which a distance between an IC chip and an optical part is short and which is excellent in reliability in electric signal transmission and transmits an optical signal via an optical signal transmitting optical path, in an optical communication part in which the IC chip is integrated with the optical part.
SOLUTION: In the IC chip mounting substrate wherein a conductor circuit and an interlayer resin insulating layer are formed by laminating on both surfaces of the substrate, a solder resist layer is formed in the outermost layer and also an optical device is mounted, an optical waveguide is formed in the inside of the IC chip mounting substrate and also the optical signal transmitting optical path which connects the optical device to the optical waveguide is formed in the same.



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CLAIMS

[Claim(s)]
[Claim 1] both sides of a substrate -- a conductor -- the substrate for IC chip mounting which is the substrate for IC chip mounting with which the optical element was mounted while laminating formation of a circuit and the resin insulating layer between layers was carried out and the solder-resist layer was formed in the outermost layer, and is characterized by to be formed the optical path for lightwave-signal transmission which connects said optical element and said optical waveguide while optical waveguide is formed in the interior of said substrate for IC chip mounting.
[Claim 2] Said optical waveguide is a substrate for IC chip mounting according to claim 1 which is organic system optical waveguide.
[Claim 3] Said optical path for lightwave signal transmission is a substrate for IC chip mounting according to claim 1 or 2 constituted by the opening.
[Claim 4] Said optical path for lightwave signal transmission is a substrate for IC chip mounting according to claim 1 or 2 constituted by the resin constituent and the opening.
[Claim 5] Said optical path for lightwave signal transmission is a substrate for IC chip mounting according to claim 1 or 2 constituted with the resin constituent.
[Claim 6] Said optical path for lightwave signal transmission is a substrate for IC chip mounting according to claim 1 or 2 constituted by the opening and the conductor layer of the perimeter.
[Claim 7] Said optical path for lightwave signal transmission is a substrate for IC chip mounting according to claim 1 or 2 constituted by the resin constituent and the opening, and the conductor layer of the perimeter.
[Claim 8] Said optical path for lightwave signal transmission is a substrate for IC chip mounting according to claim 1 or 2 constituted by the resin constituent and the conductor layer of the perimeter.
[Claim 9] The mounting position of said optical element is a substrate for IC chip mounting given in any 1 of claims 1-8 which are the front faces of the substrate for IC chip mounting.
[Claim 10] Said optical element is a substrate for IC chip mounting according to claim 9 which are a photo detector and/or a light emitting device.
[Claim 11] The substrate for IC chip mounting given in any 1 of claims 1-10 by which electronic parts are mounted in the front face of said substrate for IC chip mounting.
[Claim 12] The substrate for IC chip mounting given in any 1 of claims 1-11 by which the micro lens is formed into the edge of said optical path for lightwave signal transmission, or said optical path for lightwave signal transmission.
[Claim 13] The path of the cross section of said optical path for lightwave signal transmission is a substrate for IC chip mounting given in any 1 of claims 1-12 which are 100-500 micrometers.
[Claim 14] the conductor said whose substrate was pinched -- the conductor which between circuits was connected through the through hole and sandwiched said resin insulating layer between layers -- the substrate for IC chip mounting given in any 1 of claims 1-13 to which between circuits is connected through the Bahia hall.
[Claim 15] The manufacture approach of the substrate for IC chip mounting characterized by carrying out the laminating of a substrate, optical waveguide, and the layered product

manufactured through the process of following (a) - (c) at least in this sequence.
(a) a base material layer top -- a conductor -- a circuit and the resin insulating layer between layers -- one by one -- a laminating -- carrying out -- a conductor -- the conductor made into a circuit layered product -- a circuit layered product formation process, and (b) -- said conductor -- the solder-resist layer which has opening formed at the opening formation process which forms opening used as the optical path for lightwave-signal transmission in a circuit layered product, and the process of (c) above (b), and opening which was open for free passage -- said conductor -- the solder-resist layer formation process which forms in one side of a circuit layered product.
[Claim 16] (a) a conductor -- with the optical waveguide formation process which forms optical waveguide on the substrate with which the circuit was formed (b) -- the substrate top with which said optical waveguide was formed -- the resin insulating layer between layers, and a conductor -- with the multilayer-interconnection plate production process which carries out laminating formation of the circuit one by one, and is used as a multilayer-interconnection plate (c) The opening formation process which forms opening used as the optical path for lightwave signal transmission in said multilayer-interconnection plate, (d) The manufacture approach of the substrate for IC chip mounting characterized by including the solder resist layer formation process which forms in one side of said multilayer-interconnection plate the solder resist layer which has opening formed at the aforementioned (c) process, and opening which was open for free passage.
[Claim 17] The manufacture approach of the substrate for IC chip mounting containing the roughening side formation process which makes a roughening side the wall surface of opening used as said optical path for lightwave signal transmission according to claim 15 or 16.
[Claim 18] The manufacture approach of the substrate for IC chip mounting given in any 1 of claims 15-17 which contain in the wall surface of opening used as said optical path for lightwave signal transmission the conductor-layer formation process which forms a conductor layer.
[Claim 19] The manufacture approach of the substrate for IC chip mounting given in any 1 of claims 15-18 which contain like the resin constituent packer filled up with a non-hardened resin constituent in opening used as said optical path for lightwave signal transmission.
[Claim 20] The manufacture approach of the substrate for IC chip mounting given in any 1 of claims 15-19 containing the micro-lens formation process which forms a micro lens in the edge of opening used as said optical path for lightwave signal transmission.
[Claim 21] The manufacture approach of the substrate for IC chip mounting given in any 1 of claims 15-19 containing the micro-lens formation process which forms a micro lens into opening used as said optical path for lightwave signal transmission.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the substrate for IC chip mounting.
[0002]
[Description of the Prior Art] In recent years, attentions have gathered for the optical fiber focusing on the communication link field. In especially IT (information technology) field, the communication technology which used the optical fiber for maintenance of the high-speed Internet network is needed. In the communication system using the optical fiber which has the descriptions, such as ** low loss, ** high bandwidth, ** narrow diameter and a light weight, no ** guiding, and ** saving resources, and has this description, compared with the communication system using the conventional metallic cable, the number of repeaters can be reduced sharply, construction and maintenance become easy, and an optical fiber can attain economization of communication system, and high-reliability-ization.
[0003] Moreover, since an optical fiber can multiplex the light of the wavelength from which not only the light of one wavelength but many differ to coincidence with one optical fiber, it can realize the transmission line of the large capacity which can respond to various applications, and can respond to image service etc.
[0004] Then, in network communication, such as such the Internet, using the optical communication using an optical fiber not only for the communication link of a backbone but for the communication link with a backbone and terminal equipments (a personal computer, mobile one, game, etc.) and the communication link of terminal equipments is proposed.
[0005] Thus, when using optical communication for the communication link with a backbone and a terminal equipment etc., in order for IC which performs information (signal) processing in a terminal equipment to operate with an electrical signal, it is necessary to attach the equipment (henceforth light/electric transducer) which changes the lightwave signal and electrical signal of optical -> electric transducer, electric -> phototransducer, etc. into a terminal equipment. So, in the conventional terminal equipment, for example, optical elements, such as a package substrate which mounted IC chip, a photo detector which processes a lightwave signal, and a light emitting device, etc. were mounted separately, electric wiring and optical waveguide were connected to these, and a signal transmission and signal processing were performed. Moreover, performing optical communication of a terminal equipment using the package substrate (henceforth a package substrate with a built-in optical element) which was made to contain optical elements, such as a photo detector, in the interior of the package substrate which mounted IC chip, and contained this optical element is also proposed.
[0006]
[Problem(s) to be Solved by the Invention] In such a conventional terminal equipment, when optical elements, such as a package substrate which mounted IC chip, a photo detector which processes a lightwave signal, and a light emitting device, etc. were mounted separately, it was difficult for equipment itself to become large and to achieve the miniaturization of a terminal equipment. Moreover, the optical element was built in, and although the problem that equipment itself became large was solved when the substrate for IC chip mounting with which IC chip was

mounted was used, there were following un-arranging.
[0007] That is, in the package substrate with a built-in optical element, it was difficult to tune alignment finely, in case it connects with external optical elements (an optical fiber, optical waveguide, etc.), since the optical element is completely built in in the substrate, and since the optical element was beforehand built in in case a package substrate is manufactured, it was easy to generate a location gap of an optical element. In the production process of a package substrate, this is considered that a location gap of an optical element occurs at the time of this heat treatment, when it is necessary to perform heat treatment etc. and builds an optical element in a resin layer. Thus, when a location gap occurred in the built-in optical element, it was large and the connection loss at the time of connecting with an external optical element was led to the fall of the connection dependability in optical communication. Moreover, since it was not able to exchange only that optical element but that package substrate with a built-in optical element itself served as a defective when un-arranging occurs in either of the built-in optical elements in this package substrate with a built-in optical element, it was economically disadvantageous.
[0008] It aims at offering the substrate for IC chip mounting which can attain the optical communication which is excellent in connection dependability while this invention can be made in view of the technical problem mentioned above, can attain the miniaturization of a terminal equipment and can renew an optical element easily.
[0009]
[Means for Solving the Problem] In order to attain the above-mentioned purpose, the substrate for IC chip mounting of this invention both sides of a substrate -- a conductor, while laminating formation of a circuit and the resin insulating layer between layers is carried out and a solder resist layer is formed in the outermost layer It is the substrate for IC chip mounting with which the optical element was mounted, and while optical waveguide is formed in the interior of the above-mentioned substrate for IC chip mounting, it is characterized by forming the optical path for lightwave signal transmission which connects the above-mentioned optical element and the above-mentioned optical waveguide.
[0010] As for the above-mentioned optical waveguide, in the substrate for IC chip mounting of this invention, it is desirable that it is organic system optical waveguide.
[0011] Moreover, as for the above-mentioned optical path for lightwave signal transmission, in the substrate for IC chip mounting of this invention, it is desirable for it to be constituted by the opening, to be constituted by the resin constituent and the opening, or to be constituted with the resin constituent.
[0012] Moreover, as for the above-mentioned optical path for lightwave signal transmission, in the substrate for IC chip mounting of this invention, it is also desirable to be constituted by the opening and the conductor layer of the perimeter, to be constituted by the resin constituent and the opening, and the conductor layer of these perimeters, or to be constituted by the resin constituent and the conductor layer of the perimeter.
[0013] Moreover, in the above-mentioned substrate for IC chip mounting, as for the mounting position of the above-mentioned optical element, it is desirable that it is the front face of the substrate for IC chip mounting, and, as for the above-mentioned optical element, it is desirable that they are a photo detector and/or a light emitting device. Moreover, it is desirable to mount electronic parts in the front face of the above-mentioned substrate for IC chip mounting.
[0014] Moreover, in the above-mentioned substrate for IC chip mounting, it is desirable to form the micro lens into the edge of the above-mentioned optical path for lightwave signal transmission or the above-mentioned optical path for lightwave signal transmission, and, as for the diameter of the above-mentioned optical path for lightwave signal transmission, it is desirable that it is 100-500 micrometers.
[0015] moreover, the conductor whose above-mentioned substrate was pinched in the above-mentioned substrate for IC chip mounting -- the conductor which between circuits was connected through the through hole and sandwiched the above-mentioned resin insulating layer between layers -- it is desirable to connect between circuits through the Bahia hall.
[0016] The manufacture approach of the substrate for IC chip mounting of the first this

invention is characterized by carrying out the laminating of a substrate, optical waveguide, and the layered product manufactured through the process of following (a) - (c) at least in this sequence.
(a) a base material layer top -- a conductor -- a circuit and the resin insulating layer between layers -- one by one -- a laminating -- carrying out -- a conductor -- the conductor made into a circuit layered product -- a circuit layered product formation process and (b) above -- a conductor -- the solder-resist layer which has opening formed at the opening formation process which forms opening used as the optical path for lightwave-signal transmission in a circuit layered product, and the process of (c) above (b), and opening which were open for free passage -- the above -- a conductor -- the solder-resist layer formation process which forms in one side of a circuit layered product.
[0017] The manufacture approach of the substrate for IC chip mounting of the second this invention (a) -- a conductor -- with the optical waveguide formation process which forms optical waveguide on the substrate with which the circuit was formed (b) -- the substrate top with which the above-mentioned optical waveguide was formed -- the resin insulating layer between layers, and a conductor -- with the multilayer-interconnection plate production process which carries out laminating formation of the circuit one by one, and is used as a multilayer-interconnection plate (c) It is characterized by including the solder resist layer formation process which forms in one side of the above-mentioned multilayer-interconnection plate the solder resist layer which has opening formed at the opening formation process which forms opening used as the optical path for lightwave signal transmission, and the process of (d) above (c), and opening which was open for free passage in the above-mentioned multilayer-interconnection plate.
[0018] As for the manufacture approach of the substrate for IC chip mounting of the first or the second this invention, it is desirable to include the roughening side formation process which makes a roughening side the wall surface of opening used as the above-mentioned optical path for lightwave signal transmission. Moreover, as for the manufacture approach of the substrate for IC chip mounting of the first or the second this invention, it is desirable to include the conductor-layer formation process which forms a conductor layer in the wall surface of opening used as the above-mentioned optical path for lightwave signal transmission.
[0019] Moreover, as for the manufacture approach of the substrate for IC chip mounting of the first or the second this invention, it is desirable to contain like the resin constituent packer filled up with a non-hardened resin constituent in opening used as the above-mentioned optical path for lightwave signal transmission. Moreover, as for the manufacture approach of the substrate for IC chip mounting of the first or the second this invention, it is desirable to include the micro-lens formation process which forms a micro lens in the edge of opening used as the above-mentioned optical path for lightwave signal transmission. Moreover, as for the manufacture approach of the substrate for IC chip mounting of the first or the second this invention, it is desirable to include the micro-lens formation process which forms a micro lens into opening used as the above-mentioned optical path for lightwave signal transmission.
[0020]
[Embodiment of the Invention] Hereafter, the substrate for IC chip mounting of this invention is explained. the substrate of this invention for IC chip mounting -- both sides of a substrate -- a conductor -- it is the substrate for IC chip mounting with which an optical element was mounted while laminating formation of a circuit and the resin insulating layer between layers was carried out and the solder-resist layer was formed in the outermost layer, and while optical waveguide is formed in the interior of the above-mentioned substrate for IC chip mounting, it is characterized by to be formed the optical path for lightwave-signal transmission which connects the above-mentioned optical element and the above-mentioned optical waveguide.
[0021] Since the optical path for lightwave signal transmission which connects an optical element and the above-mentioned optical waveguide is arranged while optical waveguide is formed in the interior, the substrate for IC chip mounting of this invention can transmit the I/O signal of the above-mentioned optical element through the above-mentioned optical waveguide and the above-mentioned optical path for lightwave signal transmission. Moreover, when IC chip

is mounted in this substrate, the distance of IC chip and an optical element is short, and it excels in the dependability of electrical signal transmission. Moreover, in the substrate for IC chip mounting of this invention which mounted IC chip, since electronic parts and an optical element required for optical communication can be unified and it can connect with an external component on the side face of a substrate, thin shape-ization and miniaturizing can do this substrate for IC chip mounting more.

[0022] moreover, the case where the surface mount of the optical element is carried out -- the conductor of the above-mentioned substrate for IC chip mounting -- since an optical element is mounted after forming a circuit and the resin insulating layer between layers -- this -- a conductor -- the optical element has not been mounted at the time of heat treatment at the time of forming a circuit, the resin insulating layer between layers, etc., and the location gap which may take place at the time of heat treatment is not generated at it Moreover, it is [that what is necessary is to exchange only the optical element] economically advantageous, when the surface mount of the optical element is carried out and un-arranging occurs in the optical element of 1.

[0023] Furthermore, in the substrate for IC chip mounting of this invention, since optical waveguide is formed in the interior of this substrate for IC chip mounting, adhesion of the foreign matter to the wall surface of the above-mentioned optical waveguide is prevented and the scattered reflection of light is reduced, the transmission nature of a lightwave signal can be raised.

[0024] Optical waveguide is formed in the interior of the substrate for IC chip mounting in this invention. The inorganic system optical waveguide which consists of the organic system optical waveguide and quartz glass which consist of a polymer ingredient etc., a compound semiconductor, etc. as this optical waveguide, for example is mentioned. In these, organic system optical waveguide is desirable. While excelling in adhesion with a substrate or the resin insulating layer between layers, it is because it can be formed and processed easily.

[0025] The resin complex of the resin and thermosetting resin with which it was not limited as the above-mentioned polymer ingredient especially when there was little absorption by the communication link wavelength range, for example, some of thermosetting resin, thermoplastics, photopolymers, and thermosetting resin were photosensitivity-ized, and thermoplastics, the complex of a photopolymer and thermoplastics, etc. are mentioned. Specifically, silicone resin, such as polyimide resin, such as acrylic resin, such as PMMA (polymethylmethacrylate), Deuteration PMMA, and heavy hydrogen fluorination PMMA, and fluorination polyimide, an epoxy resin, UV hardenability epoxy resin, polyolefine system resin, and deuteration silicone resin, the polymer manufactured from benz-cyclo-butene are mentioned.

[0026] Particles, such as for example, a resin particle, an inorganic particle, and metal particles, may be contained in the above-mentioned optical waveguide in addition to the above-mentioned resinous principle. It is because adjustment of a coefficient of thermal expansion can be aimed at by including these particles between the above-mentioned optical waveguide, a substrate, the resin insulating layer between layers, a solder resist layer, etc.

[0027] What consists of resin complex of thermosetting resin, thermoplastics, a photopolymer, the resin with which some thermosetting resin was photosensitivity-ized, thermosetting resin, and thermoplastics, complex of a photopolymer and thermoplastics, etc. as the above-mentioned resin particle, for example is mentioned.

[0028] Specifically For example, an epoxy resin, phenol resin, polyimide resin, Thermosetting resin, such as a bismaleimide resin, polyphenylene resin, polyolefin resin, and a fluororesin; The heat-curing radical of these thermosetting resin A methacrylic acid, an acrylic acid, etc. are made to react to (for example, the epoxy group in an epoxy resin). Resin which gave the acrylic radical; Phenoxy resin, polyether sulfone (PES), Thermoplastics, such as polysulfone (PSF), a polyphenylene sulfone (PPS), polyphenylene sulfide (PPES), a polyphenyl ether (PPE), and polyether imide (PI); what consists of photopolymers, such as acrylic resin, etc. is mentioned. Moreover, what consists of resin complex of the resin complex of the above-mentioned thermosetting resin and the above-mentioned thermoplastics, the resin which gave the above-mentioned acrylic radical, the above-mentioned photopolymer, and the above-mentioned

thermoplastics can also be used. Moreover, the resin particle which consists of rubber can also be used as the above-mentioned resin particle.
[0029] Moreover, as the above-mentioned inorganic particle, what consists of titanium compounds, such as silicon compounds, such as magnesium compounds, such as potassium compounds, such as lime compounds, such as aluminium compounds, such as an alumina and an aluminum hydroxide, a calcium carbonate, and a calcium hydroxide, and potassium carbonate, a magnesia, a dolomite, and basic magnesium carbonate, a silica, and a zeolite, and a titania, etc. is mentioned, for example. Moreover, what consists of Lynn or phosphorus compounds can also be used as the above-mentioned inorganic particle.
[0030] As the above-mentioned metal particles, what consists of gold, silver, copper, palladium, nickel, platinum, iron, zinc, lead, aluminum, magnesium, calcium, etc. is mentioned, for example. These resin particles, an inorganic particle, and the particle of metal particles may be used independently, respectively, and may be used together two or more sorts.
[0031] Moreover, although especially the configuration of particles, such as the above-mentioned resin particle, is not limited, for example, the shape of a globular shape, an ellipse globular shape, the letter of crushing, and a polyhedron etc. is mentioned, as for the particle size of the above-mentioned particle, it is desirable that it is shorter than communication link wavelength. It is because transmission of a lightwave signal may be checked when particle size is longer than communication link wavelength.
[0032] Moreover, as mean particle diameter of the above-mentioned particle, 0.1-20 micrometers is desirable and 0.5-10 micrometers is especially desirable. As long as it is the range of this particle size, the particle of two or more kinds of different particle size may be contained. That is, it is the case where the particle whose mean particle diameter is 0.5-4 micrometers, and the particle whose mean particle diameter is 1-10 micrometers are contained etc. In addition, in this specification, particle size means the die length of the longest part of a particle.
[0033] As for the loadings of the particle which the above-mentioned optical waveguide contains, it is desirable that it is 10 - 80 % of the weight, and it is more desirable that it is 20 - 70 % of the weight. It is because transmission of a lightwave signal may be checked when the effectiveness with which a particle will be combined if the loadings of a particle are less than 10 % of the weight may not be acquired and the loadings of a particle exceed 80 % of the weight.
[0034] Moreover, although especially the configuration of the above-mentioned optical waveguide is not limited, since the formation is easy, the shape of a sheet is desirable.
[0035] moreover, the thickness of the above-mentioned optical waveguide -- 5-100 micrometers -- desirable -- a conductor -- it is more desirable that it is the same thickness as a circuit. the case where the above-mentioned optical waveguide is formed -- the front face of this optical waveguide, and the above -- a conductor -- it is because the front face of a circuit turns into the same flat surface. The width of face of the above-mentioned optical waveguide has desirable 5-100 micrometers. the conductor which constitutes the substrate for IC chip mounting if the above-mentioned width of face is not sometimes easy for the formation in less than 5 micrometers and the above-mentioned width of face exceeds 100 micrometers on the other hand -- it is because it may become the cause which checks the degree of freedom of designs, such as a circuit. Moreover, in the above-mentioned substrate for IC chip mounting, when the photo detector and the light emitting device are mounted as an optical element, it is desirable for the optical waveguide formed in the location which counters a photo detector, and the optical waveguide formed in the location which counters a light emitting device to be what consists of the same ingredient. It is because it is easy to aim at adjustment of a coefficient of thermal expansion and can be formed and processed easily.
[0036] Moreover, it is desirable to form the optical-path conversion mirror in the above-mentioned optical waveguide. By forming an optical-path conversion mirror, it is because it is possible to change an optical path into a desired include angle. Formation of the above-mentioned optical-path conversion mirror can be performed by machining at the end of optical waveguide so that it may mention later.
[0037] Especially the formation location of the above-mentioned optical waveguide is not limited,

may be formed among two or more resin insulating layers between layers, may be formed between the resin insulating layer between layers, and the solder resist layer, and may be formed between the substrate and the resin insulating layer between layers.

[0038] In the substrate for IC chip mounting of this invention, the optical path for lightwave signal transmission which connects an optical element and optical waveguide is arranged. In the substrate for IC chip mounting in which such an optical path for lightwave signal transmission was arranged, a lightwave signal can perform transfer of the information on the optical elements mounted in both sides of the above-mentioned substrate for IC chip mounting through this optical path for lightwave signal transmission.

[0039] Therefore, this optical path for lightwave signal transmission needs to be constituted so that a lightwave signal can be transmitted between the optical waveguides and the optical elements which were formed in the interior of the substrate for IC chip mounting. For example, when an optical element is arranged in the front face of the substrate for IC chip mounting and optical waveguide is formed between a substrate and the resin insulating layer between layers, or among two or more resin insulating layers between layers, the optical path for lightwave signal transmission needs to be formed in a part of resin insulating layer between layers, and solder resist layer so that a lightwave signal can be delivered and received between the light sensing portion of an optical element, or a light-emitting part.

[0040] The above-mentioned optical path for lightwave signal transmission may be constituted by the opening, may be constituted by the resin constituent and opening which can pass a lightwave signal, and may be constituted by the resin constituent which can pass a lightwave signal. When the formation is easy when the above-mentioned optical path for lightwave signal transmission is constituted by the opening, and it is constituted by the resin constituent and the opening or it is constituted by the resin constituent, the fall of the reinforcement of the substrate for IC chip mounting can be prevented.

[0041] In addition, when the above-mentioned optical path for lightwave signal transmission is formed of the resin constituent and the opening, it is desirable for the optical path for lightwave signal transmission formed in the resin insulating layer between layers to be constituted by the resin constituent, and for the optical path for lightwave signal transmission formed in the solder resist layer to be constituted by the opening. Usually, the resin insulating layer between layers has high adhesion with resin, and a solder resist layer is because adhesion with resin is low.

[0042] When a part or all of the above-mentioned optical path for lightwave signal transmission consists of resin constituents, the resin with which it was not limited as the resinous principle especially when there was little absorption by the communication link wavelength range, for example, some of thermosetting resin, thermoplastics, photopolymers, and thermosetting resin were photosensitivity-ized is mentioned. Specifically, silicone resin, such as polyimide resin, such as acrylic resin, such as an epoxy resin, UV hardenability epoxy resin, polyolefine system resin, PMMA (polymethylmethacrylate), Deuteration PMMA, and heavy hydrogen fluorination PMMA, and fluorination polyimide, and deuteration silicone resin, the polymer manufactured from benz-cyclo-butene are mentioned.

[0043] Moreover, particles, such as for example, a resin particle, an inorganic particle, and metal particles, may be contained in the above-mentioned resin constituent in addition to the above-mentioned resinous principle. By including these particles, adjustment of a coefficient of thermal expansion can be aimed at between the optical path for lightwave signal transmission, a substrate, the resin insulating layer between layers, a solder resist layer, etc., and fire retardancy can also be given depending on the class of particle.

[0044] What consists of resin complex of thermosetting resin, thermoplastics, a photopolymer, the resin with which some thermosetting resin was photosensitivity-ized, thermosetting resin, and thermoplastics, complex of a photopolymer and thermoplastics, etc. as the above-mentioned resin particle, for example is mentioned. Specifically, the same thing as the resin particle used for the above-mentioned optical waveguide etc. is mentioned. Moreover, the resin particle which consists of rubber can also be used as the above-mentioned resin particle.

[0045] Moreover, as the above-mentioned inorganic particle and the above-mentioned metal particles, the same thing as the inorganic particle and metal particles which are used for the

above-mentioned optical waveguide etc. is mentioned, for example. These resin particles, an inorganic particle, and the particle of metal particles may be used independently, respectively, and may be used together two or more sorts.

[0046] Moreover, especially the configuration of particles, such as the above-mentioned resin particle, is not limited, for example, the shape of a globular shape, an ellipse globular shape, the letter of crushing, and a polyhedron etc. is mentioned. Moreover, as for the particle size of the above-mentioned particle, it is desirable that it is shorter than communication link wavelength. It is because transmission of a lightwave signal may be checked when particle size is longer than communication link wavelength.

[0047] Moreover, as mean particle diameter, such as the above-mentioned particle, 0.1-20 micrometers is desirable and 0.5-10 micrometers is especially desirable. As long as it is the range of this particle size, the particle of two or more kinds of different particle size may be contained. That is, it is the case where the particle whose mean particle diameter is 0.5-4 micrometers, and the particle whose mean particle diameter is 1-10 micrometers are contained etc.

[0048] As for the loadings of the particle which the above-mentioned optical path for lightwave signal transmission contains, it is desirable that it is 10 - 80 % of the weight, and it is more desirable that it is 20 - 70 % of the weight. It is because transmission of a lightwave signal may be checked when the effectiveness with which a particle will be combined if the loadings of a particle are less than 10 % of the weight may not be acquired and the loadings of a particle exceed 80 % of the weight.

[0049] Moreover, especially the configuration of the above-mentioned optical path for lightwave signal transmission is not limited, for example, the shape of the shape of cylindrical and an elliptic cylinder and the square pole, many prismatic forms, etc. are mentioned. In these, the shape of a cylinder is desirable. It is because it can form easily.

[0050] Moreover, as for the path of the cross section of the above-mentioned optical path for lightwave signal transmission, it is desirable that it is 100-500 micrometers. While there is a possibility that an optical path may be closed for the diameter of the above by less than 100 micrometers, when this optical path for lightwave signal transmission consists of resin constituents, it is difficult to be filled up with a non-hardened resin constituent. the conductor which whose transmission nature of a lightwave signal seldom improves on the other hand even if it makes the diameter of the above larger than 500 micrometers, but constitutes the substrate for IC chip mounting in this case -- it is because it may become the cause which checks the degree of freedom of designs, such as a circuit. A more desirable path is 250-350 micrometers. While both the transmission nature of a lightwave signal and the degree of freedom of a design are excellent, it is because un-arranging does not occur also in case it is filled up with a non-hardened resin constituent. In addition, in the case of the shape of the diameter of the cross section, and an elliptic cylinder, in the case of the shape of the shape of the major axis of the cross section, and the square pole, or a multiple column, the path of the cross section of the above-mentioned optical path for lightwave signal transmission means the die length of the longest part of the cross section, when the above-mentioned optical path for lightwave signal transmission is a cylinder-like.

[0051] Moreover, the above-mentioned optical path for lightwave signal transmission may consist of an opening and/or a resin constituent, and a conductor layer of the perimeter. By forming the above-mentioned conductor layer, the scattered reflection of the light in the wall surface of the optical path for lightwave signal transmission can be reduced, and the transmission nature of a lightwave signal can be raised. The above-mentioned conductor layer may consist of one layer, and may consist of more than two-layer. As an ingredient of the above-mentioned conductor layer, copper, nickel, chromium, titanium, noble metals, etc. are mentioned, for example. moreover, the conductor with which the above-mentioned conductor layer sandwiched the duty as a Bahia hall, i.e., the resin insulating layer between layers, depending on the case -- the duty which connects between circuits electrically can be achieved. Moreover, it is good also as a roughening side by etching processing etc. in the front face of a conductor layer itself.

[0052] Moreover, the enveloping layer and roughening layer which consist of tin, titanium, zinc, etc. may be further prepared on the above-mentioned conductor layer. By preparing the above-mentioned enveloping layer and a roughening layer, the scattered reflection of light is reduced more, the transmission nature of a lightwave signal can be raised or the adhesion of the optical path for lightwave signal transmission, and a substrate and the resin insulating layer between layers can be raised.
[0053] Moreover, the optical path for lightwave signal transmission and the above-mentioned conductor layer which are constituted with the above-mentioned resin constituent may be in contact with the substrate or the resin insulating layer between layers through the roughening side. It is because it excels in adhesion with a substrate or the resin insulating layer between layers and is harder to generate exfoliation of the optical path for lightwave signal transmission etc., when the above-mentioned optical path for lightwave signal transmission etc. has touched through the roughening side.
[0054] Moreover, optical elements, such as a photo detector and a light emitting device, are mounted in the substrate for IC chip mounting of this invention. As the above-mentioned photo detector, PD (photodiode), APD (avalanche photodiode), etc. are mentioned, for example. What is necessary is just to use these properly suitably in consideration of the configuration of the above-mentioned substrate for IC chip mounting, demand characteristics, etc. Si, germanium, InGaAs, etc. are mentioned as an ingredient of the above-mentioned photo detector. In these, a point to InGaAs which is excellent in light-receiving sensibility is desirable.
[0055] As the above-mentioned light emitting device, LD (semiconductor laser), DFB-LD (distribution feedback mold-semiconductor laser), LED (light emitting diode), etc. are mentioned, for example. What is necessary is just to use these properly suitably in consideration of a configuration, demand characteristics, etc. of the above-mentioned substrate for IC chip mounting.
[0056] As an ingredient of the above-mentioned light emitting device, a gallium, arsenic and the compound (GaAsP) of Lynn, a gallium, aluminum and the compound (GaAlAs) of arsenic, a gallium and the compound (GaAs) of arsenic, an indium, a gallium and the compound (InGaAs) of arsenic, an indium, a gallium, arsenic, the compound (InGaAsP) of Lynn, etc. are mentioned. That what is necessary is just to use these properly in consideration of communication link wavelength, when communication link wavelength is 0.85-micrometer band, GaAlAs can be used, and in the case of 1.3-micrometer band or 1.55-micrometer band, communication link wavelength can use InGaAs and InGaAsP.
[0057] As for the mounting position of the above-mentioned optical element, it is desirable that it is the front face of the above-mentioned substrate for IC chip mounting. As mentioned above, when the optical element is mounted in the front face of the substrate for IC chip mounting and un-arranging occurs in the optical element of 1, it is because what is necessary is to exchange only the optical element. Moreover, it is desirable to also mount electronic parts, such as a capacitor, in the front face of the above-mentioned substrate for IC chip mounting. It is because only the generated inconvenient components can be exchanged like the case of the above-mentioned optical element.
[0058] It is desirable to form the micro lens into the edge of the above-mentioned optical path for lightwave signal transmission or the above-mentioned optical path for lightwave signal transmission. It is because the transmission loss of a lightwave signal can be suppressed more.
[0059] Here, the thing of the structure arranged through the glue line formed on the solder resist layer as the micro lens is formed in the edge of the above-mentioned optical path for lightwave signal transmission so that the above-mentioned micro lens might cover the edge of the optical path for lightwave signal transmission, and the structure where the above-mentioned micro lens was formed on the above-mentioned resin constituent when the above-mentioned optical path for lightwave signal transmission was constituted by the above-mentioned resin constituent is said. On the other hand, when the above-mentioned optical path for lightwave signal transmission is constituted by the resin constituent and the opening as the micro lens is formed into the above-mentioned optical path for lightwave signal transmission, it is the interior of the above-mentioned optical path for lightwave signal transmission, and the thing of the structure

where the above-mentioned micro lens is formed on the above-mentioned resin constituent is said. Moreover, the above-mentioned resin constituent consists of two-layer depending on the case, the above-mentioned micro lens is formed between the upper resin constituent and a lower layer resin constituent, and a potato is good.

[0060] It is not limited especially as the above-mentioned micro lens, but what is used for the optical lens can be mentioned, and optical glass, the resin for optical lenses, etc. are mentioned as an example of the quality of the material. As the above-mentioned resin for optical lenses, the polymer ingredient explained by the above-mentioned optical waveguides, such as acrylic resin and an epoxy resin, the same ingredient, etc. can be mentioned, for example.

[0061] moreover, the conductor whose above-mentioned substrate was pinched in the substrate for IC chip mounting of this invention -- the conductor which between circuits was connected through the through hole and sandwiched the above-mentioned resin insulating layer between layers -- it is desirable to connect between circuits through the Bahia hall. It is because the miniaturization can be attained, realizing high density wiring of the substrate for IC chip mounting.

[0062] Next, the operation gestalt of the substrate for IC chip mounting of this invention is explained, referring to a drawing. Drawing 1 is the sectional view showing typically 1 operation gestalt of the substrate for IC chip mounting of this invention. In addition, drawing 1 shows the substrate for IC chip mounting in the condition that IC chip was mounted.

[0063] it is shown in drawing 1 -- as -- the mounting substrate 220 for IC chip -- both sides of a substrate 221 -- a conductor -- the conductor with which laminating formation was carried out and the substrate 221 of the resin insulating layer [a circuit 224 and] 222 between layers was pinched -- the conductor which sandwiched the resin insulating layer 222 between layers between circuits -- between circuits, the through hole 229 and the Bahia hall 227 connect electrically, and the solder resist layer 234 is formed in the outermost layer, respectively.

[0064] moreover -- substrate 221 front face -- the conductor of the lowest layer -- the optical path 242 for lightwave signal transmission which connects the optical element (a photo detector 238 and light emitting device 239) arranged in the front face of the mounting substrate 220 for IC chip and optical waveguide 250 to the part in which optical waveguide 250 is formed in with the circuit 224, and the optical-path conversion mirror at the tip of optical waveguide 250 was formed is perpendicularly formed to the substrate 221. This optical path 242 for lightwave signal transmission consists of resin constituent 242a and opening 242b, and a conductor layer 245 formed in that perimeter. In addition, the optical path for lightwave signal transmission may be formed of the opening, and the conductor layer does not need to be formed in the perimeter.

[0065] While the surface mount of a photo detector 238 and the light emitting device 239 is carried out through the solder connection 244 as mentioned above so that each of light sensing portion 238a and light-emitting part 239a may counter the optical path 242 for lightwave signal transmission, the surface mount of the IC chip 240 is carried out to the field of 1 of the mounting substrate 220 for IC chip through the solder connection 243. Moreover, the solder bump 237 is formed in the solder resist layer 234 of other fields of the substrate 220 for IC chip mounting.

[0066] In the substrate 220 for IC chip mounting which consists of such a configuration, the lightwave signal sent from the outside through an optical fiber (not shown) etc. After receiving by the photo detector 238 (light sensing portion 238a) through optical waveguide 250 and the optical path 242 for lightwave signal transmission, it changes into an electrical signal by the photo detector 238 -- having -- further -- the solder connections 243 and 244 and a conductor -- it will be sent to the IC chip 240 through a circuit 224, the Bahia hall 227, and through hole 229 grade.

[0067] Moreover, the electrical signal sent out from the IC chip 240 the solder connections 243 and 244 and a conductor, after being sent to a light emitting device 239 through a circuit 224, the Bahia hall 227, and through hole 229 grade The lightwave signal which it was changed into the lightwave signal by the light emitting device 239, and was sent from the light emitting device 239 (light-emitting part 239a) It will be sent to the photo detector of another substrate for IC chip mounting through the optical path 242 for lightwave signal transmission, and optical

waveguide 250, and will be changed into an electrical signal, or will be sent out to external optical elements (optical fiber etc.).
[0068] In the substrate for IC chip mounting of this invention, in the photo detector and light emitting device which were mounted in the location near IC chip, since light / electrical signal conversion is performed, the transmission distance of an electrical signal is short, is excellent in the dependability of a signal transmission, and can respond to a high-speed communication link more.
[0069] Moreover, in the substrate 220 for IC chip mounting, since the solder bump 237 is formed in the solder resist layer 234 through the metal plating layer, as mentioned above, after the electrical signal sent out from IC chip is changed into a lightwave signal, it it is not only sent out outside, but will be sent to an external substrate through a solder bump through the optical-path 242 grade for lightwave signal transmission.
[0070] Thus, when the solder bump is formed, the above-mentioned substrate for IC chip mounting can be connected with an external substrate through a solder bump, and the above-mentioned substrate for IC chip mounting can be arranged to a position in this case according to the self-alignment operation which solder has.
[0071] In addition, it is thought that it happens in order that the surface tension which is going to become a globular form when solder is attached to a metal, while the operation which is going to exist in a stable configuration by near the center of opening for solder bump formation with the fluidity to which self has [solder] an above-mentioned self alignment operation at the time of reflow processing is said and, as for this operation, solder is crawled by the solder resist layer may work strongly. Though location gap has occurred to both in front of a reflow in case the above-mentioned substrate for IC chip mounting is connected to an external substrate through the above-mentioned solder bump when this self-alignment operation is used, the above-mentioned substrate for IC chip mounting can move at the time of a reflow, and this substrate for IC chip mounting can be attached in the exact location on an external substrate. Therefore, if the mounting position of the photo detector mounted in the above-mentioned substrate for IC chip mounting in the photo detector and light emitting device which were mounted in the above-mentioned substrate for IC chip mounting, and the external optical element when a lightwave signal was transmitted through optical waveguide and the optical path for lightwave signal transmission, or a light emitting device is exact, an exact lightwave signal can be transmitted between the above-mentioned substrate for IC chip mounting, and the above-mentioned external substrate.
[0072] Drawing 2 is the sectional view showing typically 1 another operation gestalt of the substrate for IC chip mounting of this invention. In addition, drawing 2 R> 2 shows the substrate for IC chip mounting in the condition that IC chip was mounted. In the substrate 320 for IC chip mounting shown in drawing 2 , micro lenses 346a and 346b are arranged in the edge of the optical path 342 for lightwave signal transmission which consists of resin constituent 342a and opening 342b, and a conductor layer 345 through the adhesives layers 347a and 347b. Thus, the transmission loss of a lightwave signal can be suppressed by arranging a micro lens. In addition, the operation gestalt of the substrate 320 for IC chip mounting is the same as the operation gestalt of the substrate 220 for IC chip mounting except having arranged micro lenses 346a and 346b. the inside of drawing 2 and 321 -- a substrate -- it is -- 322 -- the resin insulating layer between layers -- it is -- 324 -- a conductor -- it is a circuit, 327 is the Bahia hall, 338 is a photo detector, 339 is a light emitting device, 340 is IC chip, 343 and 344 are solder connections, and 350 is optical waveguide. [moreover,]
[0073] Moreover, drawing 16 is the sectional view showing typically 1 still more nearly another operation gestalt of the substrate for IC chip mounting of this invention. In addition, drawing 16 shows the substrate for IC chip mounting in the condition that IC chip was mounted. In the substrate 420 for IC chip mounting shown in drawing 16 , micro lenses 446a and 446b are formed on resin constituent 442a of the optical path 442 for lightwave signal transmission which consists of resin constituent 442a and opening 442b, and a conductor layer 445. Thus, the transmission loss of a lightwave signal can be suppressed by forming a micro lens. In addition, the operation gestalt of the substrate 420 for IC chip mounting is the same as the operation

gestalt of the substrate 220 for IC chip mounting except having formed micro lenses 446a and 446b into the optical path 442 for lightwave signal transmission. the inside of drawing 16 and 421 -- a substrate -- it is -- 422 -- the resin insulating layer between layers -- it is -- 424 -- a conductor -- it is a circuit, 427 is the Bahia hall, 438 is a photo detector, 439 is a light emitting device, 440 is IC chip, 443 and 444 are solder connections, and 450 is optical waveguide.
[moreover,] Moreover, such a substrate 420 for IC chip mounting may be constituted by the resin constituent, and its optical path 442 for lightwave signal transmission may be the structure where micro lenses 446a and 446b were formed in the edge of the optical path 442 for lightwave signal transmission.
[0074] The substrate for IC chip mounting of this invention which consists of such a configuration can be manufactured using the manufacture approach of the substrate for IC chip mounting of the first or the second this invention.
[0075] Next, the manufacture approach of the substrate for IC chip mounting of the first this invention is explained. The manufacture approach of the substrate for IC chip mounting of the first this invention is characterized by carrying out the laminating of a substrate, optical waveguide, and the layered product manufactured through the process of following (a) - (c) at least in this sequence.
(a) a base material layer top -- a conductor -- a circuit and the resin insulating layer between layers -- one by one -- a laminating -- carrying out -- a conductor -- the conductor made into a circuit layered product -- a circuit layered product formation process and (b) above -- a conductor -- the solder-resist layer which has opening formed at the opening formation process which forms opening used as the optical path for lightwave-signal transmission in a circuit layered product, and the process of (c) above (b), and opening which was open for free passage -- said conductor -- the solder-resist layer formation process which forms in one side of a circuit layered product.
[0076] while forming optical waveguide in the interior of the substrate for IC chip mounting by the manufacture approach of the substrate for IC chip mounting of the first this invention -- a conductor -- opening which was open for free passage in the circuit layered product and the solder resist layer is formed. When the substrate for IC chip mounting which this opening that was open for free passage could play a role of an optical path for lightwave signal transmission, therefore was manufactured by the manufacture approach of the first this invention mounts an optical element, it can transmit a lightwave signal suitably through the optical path for lightwave signal transmission between this optical element and optical waveguide. Moreover, by the manufacture approach of the substrate for IC chip mounting of the first this invention, after the process which forms optical waveguide, since there are few processes accompanied by heat treatment, it is hard to generate a location gap of the optical waveguide resulting from the substrate at the time of heat treatment or deformation of the resin insulating layer between layers, and the substrate for IC chip mounting excellent in connection dependability can be manufactured suitably.
[0077] By the manufacture approach of the substrate for IC chip mounting of the first this invention, after performing (A) substrate production process, (B) optical waveguide production process, and (C) layered product production process, the substrate for IC chip mounting can be manufactured by passing through the substrate manufactured at these processes, optical waveguide, and (D) laminating process which carries out the laminating of the layered product in this sequence. Hereafter, these are explained in order.
[0078] (A) a substrate production process insulation substrate -- a start ingredient -- carrying out -- the need -- responding -- this insulating substrate top -- a conductor -- form a circuit. As the above-mentioned insulating substrate, a glass epoxy group plate, a polyester substrate, a polyimide substrate, a bismaleimide-triazine (BT) resin substrate, a thermosetting polyphenylene ether substrate, copper clad laminate, a RCC substrate, etc. are mentioned, for example. Moreover, a ceramic substrate, silicon radicals, etc., such as an alumimium nitride substrate, may be used. the above -- a conductor -- a circuit can be formed by performing etching processing, after forming a solid conductor layer in the front face of for example, the above-mentioned insulating substrate by nonelectrolytic plating processing etc. Moreover, you may form by

performing etching processing to copper clad laminate or a RCC substrate.
[0079] moreover, the insulating above-mentioned substrate top -- a conductor -- the conductor whose above-mentioned insulating substrate formed the circuit and was pinched -- in making connection between circuits by the through hole, after using a drill, laser, etc. for example, for the above-mentioned insulating substrate and forming the through tube for through holes, the through hole is formed by performing nonelectrolytic plating processing etc. In addition, the diameter of the above-mentioned through tube for through holes is usually 100-300 micrometers. Moreover, when a through hole is formed, it is desirable to be filled up with a resin filler in this through hole.
[0080] (B) an optical waveguide production process -- here, form the optical waveguide fabricated in the shape of a film. In the case of the organic system optical waveguide which the above-mentioned optical waveguide turns into from a polymer ingredient etc., this organic system optical waveguide can be formed using for example, a selective polymerization method, the method of using reactive ion etching and photolithography, the direct exposing method, the approach using injection molding, the photograph breeching method, the approach that combined these by fabricating a polymer ingredient in the shape of a film on a mold releasing film etc. Moreover, in the case of the inorganic system optical waveguide which the above-mentioned optical waveguide turns into from quartz glass, a compound semiconductor, etc., this inorganic system optical waveguide can form the inorganic material of LiNbO3 and LiTaO3 grade by making an inorganic material form on a mold releasing film etc. using a liquid-phase-epitaxial method, the chemistry depositing method (CVD), a molecular beam epitaxy, etc.
[0081] Moreover, an optical-path conversion mirror is formed in the above-mentioned optical waveguide. It is not limited especially as an approach of forming the above-mentioned optical-path conversion mirror, but the well-known formation approach can be used conventionally. Specifically, machining with the diamond saw and cutter whose tip is 90 degrees of V types, processing by reactive ion etching, laser ablation, etc. can be used.
[0082] (C) Manufacture the layered product production process above-mentioned layered product by passing through the process of following (a) - (c) at least.
(a) a base material layer top -- a conductor -- a circuit and the resin insulating layer between layers -- one by one -- a laminating -- carrying out -- a conductor -- the conductor made into a circuit layered product -- a circuit layered product formation process and (b) above -- a conductor -- the solder-resist layer which has opening formed at the opening formation process which forms opening used as the optical path for lightwave-signal transmission in a circuit layered product, and the process of (c) above (b), and opening which were open for free passage -- the above -- a conductor -- the solder-resist layer formation process which forms in one side of a circuit layered product.
[0083] first, the process of the above (a), i.e., a conductor, -- the conductor which forms a circuit layered product -- a circuit layered product formation process is explained in order of a process. Specifically, it can carry out by passing through the process of following the (1) - (9).
(1) the base material layer fabricated in the shape of a film -- a start ingredient -- carrying out -- this base material layer top -- a conductor -- form a circuit. The non-hardened resin with which some of thermosetting resin, photopolymers, and thermosetting resin consist of the acrylic-ized resin, these and thermoplastics, included resin complex as the above-mentioned base material layer, for example is fabricated in the shape of a film, and what performed hardening processing, the thing which fabricated thermoplastics etc. in the shape of a film are mentioned.
[0084] As the above-mentioned thermosetting resin, an epoxy resin, phenol resin, polyimide resin, polyester resin, a bismaleimide resin, polyolefine system resin, polyphenylene ether resin, polyphenylene resin, a fluororesin, etc. are mentioned, for example. As an example of the above-mentioned epoxy resin, novolak mold epoxy resins, such as a phenol novolak mold and a cresol novolak mold, the cycloaliphatic epoxy resin which carried out dicyclopentadiene conversion are mentioned, for example.
[0085] As the above-mentioned photopolymer, acrylic resin etc. is mentioned, for example. Moreover, the thing to which the heat-curing radical, and the methacrylic acid and acrylic acid of

the above-mentioned thermosetting resin were made to acrylic--ization-react as resin which acrylic-ized some above-mentioned thermosetting resin for example, is mentioned.
[0086] As the above-mentioned thermoplastics, phenoxy resin, polyether sulfone (PES), polysulfone (PSF), polyphenylene sulfone (PPS) polyphenylene sulfide (PPES), polyphenylene ether (PPE) polyether imide (PI), etc. are mentioned, for example.
[0087] Moreover, as the above-mentioned resin complex, especially if thermosetting resin, a photopolymer (the resin which acrylic-ized some thermosetting resin is also included), and thermoplastics are included, it will not be limited, but as a concrete combination of thermosetting resin and thermoplastics, phenol resin / polyether sulfone, polyimide resin/polysulfone, an epoxy resin / polyether sulfone, an epoxy resin/phenoxy resin, etc. are mentioned, for example. Moreover, as a concrete combination of a photopolymer and thermoplastics, acrylic resin/phenoxy resin, an epoxy resin / polyether sulfone etc. that acrylic-ized a part of epoxy group are mentioned, for example.
[0088] Moreover, as for the rate of a compounding ratio of thermosetting resin and the photopolymer in the above-mentioned resin complex, and thermoplastics, thermosetting resin or a photopolymer / thermoplastics =95 / 5 - 50/50 are desirable. It is because a high toughness value is securable, without spoiling thermal resistance. Moreover, the above-mentioned base material layer may consist of resin layers from which it differs more than two-layer.
[0089] Moreover, the above-mentioned base material layer may fabricate the resin constituent for roughening side formation in the shape of a film, and may perform hardening processing. In addition, behind, the above-mentioned resin constituent for roughening side formation is explained in full detail, in case the formation approach of the resin insulating layer between layers is explained.
[0090] moreover, the conductor formed on the above-mentioned base material layer -- a circuit can be formed by performing etching processing etc., after forming a solid conductor layer in the front face of for example, the above-mentioned base material layer by nonelectrolytic plating processing etc. moreover, the thing for which etching processing is performed -- a conductor -- the approach of forming a circuit -- replacing with -- the part on a solid conductor layer -- the approach of forming plating resist, forming an electrolysis plating layer in the plating-resist agenesis section after that, and removing further the conductor layer which exists under plating resist and this plating resist -- using -- a conductor -- a circuit may be formed.
[0091] moreover, the conductor whose above-mentioned base material layer was pinched -- in making connection between circuits by the through hole, after using laser etc. for example, for the above-mentioned base material layer and forming the through tube for through holes, the through hole is formed by performing nonelectrolytic plating processing etc. In addition, the diameter of the above-mentioned through tube for through holes is usually 100-300 micrometers. Moreover, when a through hole is formed, it is desirable to be filled up with a resin filler in this through hole.
[0092] (2) next, the need -- responding -- a conductor -- perform roughening formation processing on the surface of a circuit. as the above-mentioned roughening formation processing -- melanism (oxidization) -- the etching processing using the etching reagent containing - reduction processing, the second ccpper complex, and an organic-acid salt etc., processing by the Cu-nickel-P needlelike alloy plating, etc. are mentioned. the case where a roughening side is formed here -- the average roughness of this roughening side -- usually -- 0.1-5 micrometers -- desirable -- a conductor -- the adhesion of a circuit and the resin insulating layer between layers, and a conductor -- when the effect to the electrical signal transmission ability of a circuit etc. is taken into consideration, 2-4 micrometers is more desirable. In addition, before this roughening formation processing is filled up with a resin filler in a through hole, it may be performed, and it may form a roughening side also in the wall surface of a through hole. It is because the adhesion of a through hole and a resin filler improves.
[0093] (3) next, a conductor -- form the resin layer which forms the resin layer which is not hardened [which some of thermosetting resin photopolymers, and thermosetting resin become from the acrylic-ized resin, these and thermoplastics, and the included resin complex] on the base material layer in which the circuit was formed, or consists of thermoplastics. In addition, the

resin used in case for example, a base material layer is formed, the same resin, etc. can be used for formation of these resin layers.
[0094] Moreover, the resin layer which is not hardened [which is formed here] and the resin layer which consists of thermoplastics may consist of two or more sorts of different resin layers. It is that a lower layer is formed from thermosetting resin or the resin complex of a photopolymer / thermoplastics =50/50, and the upper layer specifically consists of thermosetting resin or resin complex of a photopolymer / thermoplastics =90/10 etc. While securing the outstanding adhesion with a substrate by making it such a configuration, the formation ease at the time of forming opening for the Bahia halls etc. at a back process is securable.
[0095] The resin layer which is not hardened [above-mentioned] can be formed by applying non-hardened resin by the roll coater, a curtain coating machine, etc., or carrying out thermocompression bonding of the resin film non-hardened (semi-hardening). Moreover, the resin layer which consists of the above-mentioned thermoplastics can be formed by carrying out thermocompression bonding of the resin Plastic solid fabricated on the film.
[0096] Thermocompression bonding of the above-mentioned resin complex or a resin Plastic solid can be performed for example, using a vacuum laminator etc. Moreover, although what is necessary is not to limit especially sticking-by-pressure conditions, but just to choose suitably in consideration of the presentation of a resin film etc., it is usually desirable to carry out on a pressure 0.25 - 1.0MPa, the temperature of 40-70 degrees C, the degree of vacuum of 13-1300Pa, and about [time amount 10-120 second] conditions.
[0097] Moreover, the resin layer which is not hardened [above-mentioned] may be formed using the resin constituent for roughening side formation. The matter of fusibility is distributed to the roughening liquid which consists of at least one sort chosen from an acid, alkali, and an oxidizer into the heat-resistant-resin matrix which is not hardened [poorly soluble] to the roughening liquid which serves as the above-mentioned resin constituent for roughening side formation from at least one sort chosen from an acid, alkali, and an oxidizer. In addition, when the same time amount immersion is carried out, the word of the above "poor solubility" and "fusibility" says relatively what has an early dissolution rate as "fusibility" to the same roughening liquid for convenience, and calls "poor solubility" relatively what has a late dissolution rate to it for convenience.
[0098] In case the above-mentioned roughening liquid is used for the resin insulating layer between layers and a roughening side is formed as the above-mentioned heat-resistant-resin matrix, what can hold the configuration of a roughening side is desirable, for example, thermosetting resin, thermoplastics, these complex, etc. are mentioned.
[0099] As the above-mentioned thermosetting resin, an epoxy resin, phenol resin, polyimide resin, polyolefin resin, a fluororesin, etc. are mentioned, for example. Moreover, when sensitization-izing the above-mentioned thermosetting resin, a heat-curing radical is made to acrylic(meta)--ization-react using a methacrylic acid, an acrylic acid, etc.
[0100] As the above-mentioned epoxy resin, a cresol novolak mold epoxy resin, the bisphenol A mold epoxy resin, a bisphenol female mold epoxy resin, a phenol novolak mold epoxy resin, an alkylphenol novolak mold epoxy resin, a biphenol female mold epoxy resin, a naphthalene mold epoxy resin, a dicyclopentadiene mold epoxy resin, the epoxidation object of the condensate of phenols and the aromatic aldehyde which has a phenolic hydroxyl group, triglycidyl isocyanurate, cycloaliphatic epoxy resin, etc. are mentioned, for example. These may be used independently and may be used together two or more sorts. Thereby, it excels in thermal resistance etc.
[0101] As the above-mentioned thermoplastics, phenoxy resin, polyether sulfone, polysulfone, polyphenylene sulfone, polyphenylene sulfide, a polyphenyl ether, polyether imide, etc. are mentioned, for example. These may be used independently and may be used together two or more sorts.
[0102] As matter of fusibility, an inorganic particle, a resin particle, metal particles, a rubber particle, the particle that consists of liquid phase resin or liquid phase rubber are mentioned to the roughening liquid which consists of at least one sort chosen from the above-mentioned acid, alkali, and an oxidizer, for example. In these, an inorganic particle, a resin particle, and metal

particles are desirable.
[0103] As the above-mentioned inorganic particle, what consists of silicon compounds, such as magnesium compounds, such as potassium compounds, such as lime compounds, such as aluminium compounds, such as an alumina and an aluminum hydroxide, a calcium carbonate, and a calcium hydroxide, and potassium carbonate, a magnesia, a dolomite, basic magnesium carbonate, and talc, a silica, and a zeolite, etc. is mentioned, for example. These may be used independently and may be used together two or more sorts. Dissolution removal of the above-mentioned alumina particle can be carried out by fluoric acid, and dissolution removal of the calcium carbonate can be carried out with a hydrochloric acid. Moreover, dissolution removal of a sodium content silica or the dolomite can be carried out in an alkali water solution.
[0104] As the above-mentioned resin particle, what consists of thermosetting resin, thermoplastics, etc. is mentioned, for example. When immersed in the roughening liquid which consists of at least one sort chosen from an acid, alkali, and an oxidizer It will not be limited especially if a dissolution rate is earlier than the above-mentioned heat-resistant-resin matrix. Specifically For example, what consists of amino resin (melamine resin, a urea-resin, guanamine resin, etc.), an epoxy resin, phenol resin, phenoxy resin, polyimide resin, polyphenylene resin, polyolefin resin, a fluororesin, bismaleimide-triazine resin, etc. is mentioned. These may be used independently and may be used together two or more sorts. In addition, the above-mentioned resin particle needs to carry out hardening processing beforehand. It is because the above-mentioned resin particle will dissolve in the solvent in which a resin matrix is dissolved if it is not made to harden.
[0105] As the above-mentioned metal particles, what consists of gold, silver, copper, tin, zinc, stainless steel, aluminum, nickel, iron, lead, etc. is mentioned, for example. These may be used independently and may be used together two or more sorts. Moreover, the surface may be covered with resin etc. in order that the above-mentioned metal particles may secure insulation.
[0106] When two or more sorts are mixed and it uses the matter of the above-mentioned fusibility, as a combination of the matter of two sorts of fusibility to mix, the combination of a resin particle and an inorganic particle is desirable. the resin insulating layer between layers which adjustment of thermal expansion tends to plan them between poorly soluble resin, and they become from the resin constituent for roughening side formation while both of conductivity can be hurt low and can secure the insulation of the resin insulating layer between layers -- a crack -- not generating -- the resin insulating layer between layers, and a conductor -- it is because exfoliation does not occur between circuits.
[0107] It is desirable to use an organic acid in these as an acid used as the above-mentioned roughening liquid, for example, although organic acids, such as a phosphoric acid, a hydrochloric acid, a sulfuric acid, a nitric acid, and formic acid, an acetic acid, etc. are mentioned. It is because it is hard to make the metallic conductor layer exposed from the Bahia hall corrode when roughening processing is carried out. As the above-mentioned oxidizer, it is desirable to, use the water solution of a chromic acid, chromate acid mixture, and alkaline permanganates (potassium permanganate etc.) etc. for example. Moreover, as the above-mentioned alkali, water solutions, such as a sodium hydroxide and a potassium hydroxide, are desirable.
[0108] The mean particle diameter of the matter of the above-mentioned fusibility has desirable 10 micrometers or less. Moreover, big coarse grain and mean particle diameter may use it combining a small particle relatively relatively [mean particle diameter]. That is, it is combining the matter of the fusibility whose mean particle diameter's is 0.1-0.8 micrometers, and the matter of the fusibility whose mean particle diameter's is 0.8-2.0 micrometers etc.
[0109] Thus, when big coarse grain and mean particle diameter combine a small particle relatively relatively [particle / average], the dissolution residue of a thin film conductor layer can be lost, the amount of palladium catalysts under plating resist can be lessened, and a still shallower and complicated roughening side can be formed. Furthermore, by forming a complicated roughening side, even if the irregularity of a roughening side is small, the practical Peel reinforcement is maintainable.
[0110] (4) Next, in forming the resin insulating layer between layers using thermosetting resin and resin complex as the ingredient, while performing hardening processing to a non-hardened

resin insulating layer, form opening for the Bahia halls and consider as the resin insulating layer between layers. Moreover, at this process, the through tube for through holes may be formed if needed. As for the above-mentioned opening for the Bahia halls, forming by the lasing is desirable. Moreover, when a photopolymer is used as an ingredient of the resin insulating layer between layers, you may form by the exposure development.

[0111] Moreover, in forming the resin insulating layer between layers using thermoplastics as the ingredient, opening for the Bahia halls is formed in the resin layer which consists of thermoplastics, and it considers as the resin insulating layer between layers. In this case, opening for the Bahia halls can be formed by giving the lasing. Moreover, what is necessary is just to form this through tube for through holes by the lasing etc., when forming the through tube for through holes at this process.

[0112] As laser used for the above-mentioned lasing, carbon dioxide gas laser, ultraviolet laser, excimer laser, etc. are mentioned, for example. In these, excimer laser and the carbon dioxide gas laser of a short pulse are desirable.

[0113] Moreover, it is desirable also in excimer laser to use the excimer laser of a hologram method. A hologram method is a method which irradiates a laser beam through a hologram, a condenser lens, a laser mask, an imprint lens, etc. at the specified substance, and much openings for the Bahia halls can be once formed in a resin layer efficiently by exposure by using this method.

[0114] Moreover, when using carbon dioxide gas laser, as for the pulse separation, it is desirable that they are 10-4 - 10 to 8 seconds. Moreover, as for the time amount which irradiates the laser for forming opening, it is desirable that it is 10 - 500 microseconds. Moreover, much openings for the Bahia halls can be formed at once by irradiating a laser beam through an optical-system lens and a mask. By minding an optical-system lens and a mask, it is the same reinforcement and is because exposure reinforcement can irradiate the same laser beam at two or more parts. Thus, after forming opening for the Bahia halls, DESUMIA processing may be performed if needed.

[0115] In addition, the same thing of the quality of the material of the resin insulating layer between layers formed at this process and the quality of the material of the above-mentioned base material layer is desirable. It is because physical properties, such as a coefficient of thermal expansion, become the same among both.

[0116] (5) Next, form a thin film conductor layer in the front face of the resin insulating layer between layers including the wall of opening for the Bahia halls. The above-mentioned thin film conductor layer can be formed by approaches, such as nonelectrolytic plating and sputtering.

[0117] As the quality of the material of the above-mentioned thin film conductor layer, copper, nickel, tin, zinc, cobalt, a thallium, lead, etc. are mentioned, for example. In these, what consists of the copper from a point, copper, and nickel which are excellent in an electrical property, economical efficiency, etc. is desirable. Moreover, as thickness of the above-mentioned thin film conductor layer, when forming a thin film conductor layer with nonelectrolytic plating, 0.3-2.0 micrometers is desirable and 0.6-1.2 micrometers is more desirable. Moreover, when forming by sputtering, 0.1-1.0 micrometers is desirable.

[0118] Moreover, a roughening side may be formed in the front face of the resin insulating layer between layers before forming the above-mentioned thin film conductor layer. By forming a roughening side, the adhesion of the resin insulating layer between layers and a thin film conductor layer can be raised. When the resin insulating layer between layers is especially formed using the resin constituent for roughening side formation, it is desirable to form a roughening side using an acid, an oxidizer, etc.

[0119] Moreover, when the through tube for through holes is formed at the process of the above (4), in case a thin film conductor layer is formed on the resin insulating layer between layers, it is good also as a through hole by forming a thin film conductor layer also in the wall surface of a through tube.

[0120] (6) Subsequently, form plating resist in a part of resin insulating layer between layers by which the thin film conductor layer was formed in the front face. After the above-mentioned plating resist sticks for example, a photosensitive dry film, it can carry out adhesion arrangement

of the photo mask which consists of a glass substrate with which the plating resist pattern was drawn, and can form it by performing an exposure development.
[0121] (7) After that, perform electrolysis plating liquid by making a thin film conductor layer into a plating bar, and form an electrolysis plating layer in the above-mentioned plating-resist agenesis section. As the above-mentioned electrolysis plating liquid, copper plating is desirable. Moreover, the thickness of the above-mentioned electrolysis plating layer and 5-20 micrometers are desirable.
[0122] then, the thing for which the thin film conductor layer under the above-mentioned plating resist and this plating resist is removed -- a conductor -- a circuit (the Bahia hall is included) can be formed. What is necessary is just to perform removal of the above-mentioned thin film conductor layer using etching reagents, such as mixed liquor of a sulfuric acid and a hydrogen peroxide, sodium persulfate, ammonium persulfate, a ferric chloride, and a cupric chloride, that what is necessary is just to perform removal of the above-mentioned plating resist for example, using an alkali water solution etc. moreover, the above -- a conductor -- after forming a circuit, the catalyst on the resin insulating layer between layers may be removed using an acid or an oxidizer if needed. It is because the fall of an electrical property can be prevented. moreover, the thing for which etching processing is performed after replacing with the approach (a process (6) and (7)) of forming an electrolysis plating layer after forming this plating resist and forming an electrolysis plating layer the whole surface on a thin film conductor layer -- a conductor -- the approach of forming a circuit may be used.
[0123] Moreover, when a through hole is formed in the above (4) and the process of (5), it may be filled up with a resin filler in this through hole. Moreover, when filled up with a resin filler in a through hole, a wrap lid plating layer may be formed for the surface section of a resin filler layer by performing nonelectrolytic plating if needed.
[0124] (8) Next, when a lid plating layer is formed, if needed, perform roughening processing on the front face of this lid plating layer, and form the resin insulating layer between layers by repeating the above (3) and the process of (4) further. In addition, a through hole may be formed and it is not necessary to form at this process.
(9) -- repeating the process of (5) - (8) further if needed -- a conductor -- laminating formation of a circuit and the resin insulating layer between layers may be carried out.
[0125] passing through the process of such (1) - (9) -- both sides of a base material layer -- a conductor -- the conductor with which laminating formation of a circuit and the resin insulating layer between layers was carried out -- a circuit layered product can be manufactured. in addition, the conductor explained in full detail here -- the manufacture approach of a circuit layered product -- semi ADITEBU -- the conductor manufactured at the process of the above (a) although it is law -- the manufacture approach of a circuit layered product -- semi ADITEBU -- it limits to law -- not having -- full ADITEBU -- it can also carry out using law, a subtractive process, a package laminated layers method, the conformal method, etc. the inside of these -- semi ADITEBU -- law and full ADITEBU -- ADITEBU of law -- law is desirable. since etching precision is high -- a more detailed conductor -- while it is suitable for forming a circuit -- a conductor -- it is because the degree of freedom of a design of a circuit improves.
[0126] pass the process of the above (a) -- a conductor -- the process of the above (b) after manufacturing a circuit layered product, i.e., the above, -- a conductor -- the opening formation process which forms opening used as the optical path for lightwave signal transmission in a circuit layered product is performed. Opening formed at this process will play the role of the optical path for lightwave signal transmission in the substrate for IC chip mounting. Therefore, opening formed at this process is hereafter called opening for lightwave signal transmission.
[0127] The lasing etc. performs formation of the above-mentioned opening for lightwave signal transmission. As laser used in the above-mentioned lasing, the same thing as the laser used in formation of the above-mentioned opening for the Bahia halls etc. is mentioned, for example. especially the formation location of the above-mentioned opening for lightwave signal transmission is limited -- not having -- a conductor -- what is necessary is just to choose suitably in consideration of the mounting position of the design of a circuit, and IC chip etc. Moreover, as for the above-mentioned opening for lightwave signal transmission, it is desirable to

form for every optical elements, such as a photo detector and a light emitting device. Moreover, you may form for every signal wave length.
[0128] Moreover, after forming opening for lightwave signal transmission, DESUMIA processing may be performed to the wall surface of opening for lightwave signal transmission if needed. The above-mentioned DESUMIA processing can be performed using processing for example, by the permanganic acid solution, plasma treatment, corona treatment, etc. In addition, by performing the above-mentioned DESUMIA processing, the resin remainder in opening for lightwave signal transmission, weld flash, etc. can be removed, and the transmission loss resulting from the scattered reflection in the wall surface of the optical path for lightwave signal transmission can be reduced.
[0129] Moreover, after the opening formation for lightwave signal transmission, before forming a conductor layer or filling up a non-hardened resin constituent with the following process, it is desirable to perform the roughening side formation process which makes a roughening side the wall surface of opening for lightwave signal transmission if needed. It is because adhesion with a conductor layer or a resin constituent can be raised. Formation of the above-mentioned roughening side can be performed by dissolving the part exposed with oxidizers, such as acid; chromic acids, such as a sulfuric acid, a hydrochloric acid, and a nitric acid, chromate acid mixture, and a permanganate, etc. when openings for lightwave signal transmission, such as a resin insulating layer between layers, were formed. Moreover, plasma treatment, corona treatment, etc. can also perform. The average roughness (Ra) of the above-mentioned roughening side has desirable 0.5-5 micrometers, and its 1-3 micrometers are more desirable. if it is this range, it excels in adhesion with a conductor layer or a resin constituent -- it is both because it does not have a bad influence on transmission of a lightwave signal.
[0130] After forming the above-mentioned opening for lightwave signal transmission, it is desirable to perform the conductor-layer formation process which forms a conductor layer in the wall surface of the above-mentioned opening for lightwave signal transmission if needed. Formation of the above-mentioned conductor layer can be performed by approaches, such as nonelectrolytic plating and sputtering. After forming opening for lightwave signal transmission, a catalyst nucleus can be given to the wall surface of this opening for lightwave signal transmission, and, specifically, the approach immersed in a nonelectrolytic plating bath in the substrate with which opening for lightwave signal transmission was formed can be used after that. Moreover, the conductor layer which consists of more than two-layer combining nonelectrolytic plating or sputtering may be formed, and the conductor layer which performs electrolysis plating and consists of more than two-layer may be formed after nonelectrolytic plating or sputtering.
[0131] the resin insulating-layer top between layers of the outermost layer formed at the process of the above (a) in such a conductor-layer formation process while forming the conductor layer in the wall surface of the above-mentioned opening for lightwave signal transmission -- the conductor of the outermost layer -- it is desirable to form a circuit. First, in case a conductor layer is formed in the wall surface of opening for lightwave signal transmission with nonelectrolytic plating etc., specifically, a conductor layer is formed also in the whole front face of the resin insulating layer between layers.
[0132] Next, plating resist is formed on the conductor layer formed in this resin insulating-layer front face between layers. What is necessary is for formation of plating resist to carry out adhesion installation of the photo mask which consists of a glass substrate with which the plating resist pattern was drawn, and just to perform it by performing an exposure development, after sticking for example, a photosensitive dry film.
[0133] furthermore, the conductor which became independent on the resin insulating layer between layers of the outermost layer by performing electrolysis plating by making into a plating bar the conductor layer formed on the above-mentioned resin insulating layer between layers, forming an electrolysis plating layer in the above-mentioned plating-resist agenesis section, and removing the conductor layer under the above-mentioned plating resist and this plating resist after that -- a circuit is formed.
[0134] Moreover, a roughening side may be formed in the wall surface of the above-mentioned

conductor layer after forming the above-mentioned conductor layer. formation of the above-mentioned roughening side -- for example, melanism (oxidization) -- it can carry out using the etching processing using the etching reagent containing - reduction processing, the second copper complex, and an organic-acid salt etc., processing by the Cu-nickel-P needlelike alloy plating, etc.

[0135] Moreover, after forming the above-mentioned opening for lightwave signal transmission, it is desirable to carry out like the resin constituent packer who fills up this opening with a non-hardened resin constituent if needed. After being filled up with a non-hardened resin constituent, the optical path for lightwave signal transmission which consists of a resin constituent and an opening, or the optical path for lightwave signal transmission which consists of resin constituents can be formed by performing hardening processing. It is not limited especially as the restoration approach of the resin constituent which is not hardened [concrete], for example, approaches, such as printing and potting, can be used. In addition, when filled up with a non-hardened resin constituent by printing, a non-hardened resin constituent may be printed at once and may be printed in 2 steps or more. moreover, a conductor -- printing may be performed from both sides of a circuit layered product.

[0136] Moreover, in case it is filled up with a non-hardened resin constituent, it may be filled up with the resin constituent which is not hardened [of somewhat many amounts], and the excessive resin constituent with which it overflowed from opening for lightwave signal transmission may be removed from the inner product of the above-mentioned opening for lightwave signal transmission after restoration termination. the above -- polish etc. can perform removal of an excessive resin constituent. Moreover, what is necessary is for the condition of a resin constituent to be in a semi-hardening condition, to be in the condition hardened completely, and just to choose it suitably in consideration of the ingredient of a resin constituent etc., when removing an excessive resin constituent. In addition, when not carrying out like the above-mentioned resin constituent packer, the optical path for lightwave signal transmission which consists of openings can be formed.

[0137] pass the process of the above (a) by passing like such an opening formation process, the roughening side formation process performed if needed, a conductor-layer formation process, and a resin constituent packer -- the manufactured conductor -- a part of optical path for lightwave signal transmission can be formed in a circuit layered product. moreover, the conductor which became independent by forming a conductor layer also in the front face of the resin insulating layer between layers, and performing processing mentioned above in case the above-mentioned conductor-layer formation process is performed -- a circuit can be formed. of course, the approach mentioned above even if it was the case where the process which forms the above-mentioned conductor layer was not performed -- the front face of the resin insulating layer between layers -- a conductor -- a circuit can be formed.

[0138] Next, the solder resist layer formation process which forms the solder resist layer which has opening which was open for free passage to opening formed at the process of the above (c), i.e., the process of the above (b), is performed. Specifically, a solder resist layer can be formed by performing following (1) and the process of (2). in addition, a solder resist layer -- a conductor -- what is necessary is just to form in one side of a circuit layered product

[0139] (1) the conductor which formed opening for lightwave signal transmission first -- form the layer of a solder resist constituent in one side of a circuit layered product. The layer of the above-mentioned solder resist constituent can be formed using the solder resist constituent which consists of for example, polyphenylene ether resin, polyolefin resin, a fluororesin; thermoplastic elastomer, an epoxy resin, polyimide resin, etc.

[0140] moreover, as solder resist constituents other than the above For example, the acrylate (meta) of a novolak mold epoxy resin, an imidazole curing agent, 2 functionality (meta) acrylic ester monomer, the polymer of with a molecular weight of about 500 to 5000 acrylic ester (meta), The fluid of the shape of a paste containing photosensitive monomers, such as thermosetting resin which consists of a bisphenol mold epoxy resin etc., and a multiple-valued acrylic monomer, a glycol ether system solvent, etc. is mentioned, and, as for the viscosity, it is desirable to be adjusted to 1 - 10 Pa-s at 25 degrees C. Moreover, the film which consists of

the above-mentioned solder resist constituent is stuck by pressure, and the layer of a solder resist constituent may be formed. Especially when opening for lightwave signal transmission is constituted by the opening, it is desirable to stick a film by pressure and to form the layer of a solder resist constituent.

[0141] (2) Next, form in the layer of the above-mentioned solder resist constituent opening (henceforth opening for optical paths) which was open for free passage to the above-mentioned opening for lightwave signal transmission. Specifically, it can form by the exposure development, the lasing, etc. Moreover, in case the above-mentioned opening for optical paths is formed, it is desirable to form opening for solder bump formation in coincidence. In addition, formation and formation of the above-mentioned opening for solder bump formation are [opening / above-mentioned / for optical paths] separately good in a line. Moreover, in case a solder resist layer is formed, the solder resist layer which has opening for optical paths and opening for solder bump formation may be formed by producing the resin film which has opening in a desired location, and sticking this resin film on it beforehand.

[0142] Moreover, the path of the cross section of the above-mentioned opening for optical paths may be smaller than the path of the cross section of the above-mentioned opening for lightwave signal transmission. In this case, what is necessary is just to make the path of the cross section of the above-mentioned optical-path opening smaller 20-100 micrometers than the path of the cross section of the above-mentioned opening for lightwave signal transmission.

[0143] the conductor with which opening for lightwave signal transmission was formed by passing through such a process of (1) and (2) -- the solder resist layer which has this opening for lightwave signal transmission and opening which was open for free passage can be formed in one side of a circuit layered product. In addition, by the manufacture approach of the substrate for IC chip mounting of the first this invention, a solder resist layer may be formed after (D) laminating process mentioned later.

[0144] Moreover, when a non-hardened resin constituent is filled up with the opening formation process of the above (b) into opening for lightwave signal transmission, a non-hardened resin constituent may be filled up with the same approach as the above-mentioned opening for lightwave signal transmission into opening for optical paths formed in the above-mentioned solder resist layer. Thus, after filling up opening for optical paths of a solder resist layer with a non-hardened resin constituent, the optical path for lightwave signal transmission which consists of resin constituents can be formed by performing hardening processing of the resin constituent which is not hardened [this].

[0145] Such (a) After performing the process of - (c), a layered product can be manufactured by performing solder pad formation using the following approach. namely, the conductor exposed by forming the above-mentioned opening for solder bump formation -- if needed, a circuit part is covered with corrosion-resistant metals, such as nickel, palladium, gold, silver, and platinum, and let it be a solder pad. In these, it is desirable to form an enveloping layer with metals, such as nickel-gold, nickel-silver, nickel-palladium, and nickel-palladium-gold. Although the above-mentioned enveloping layer can be formed according to plating, vacuum evaporationo, electrodeposition, etc., in these, it is desirable to form with plating from the point of excelling in the homogeneity of an enveloping layer.

[0146] (D) Carry out the laminating of the optical waveguide manufactured at the process of the above (B) on the substrate manufactured at the process of the laminating process above (A), and the layered product manufactured at the process of the above (C). As for this laminating, it is desirable to carry out by thermocompression bonding, for example, it can perform it using a vacuum laminator etc. Moreover, although what is necessary is just to choose suitably in consideration of the presentation of the resin which especially sticking-by-pressure conditions are not limited, but is used for the above-mentioned optical waveguide and the above-mentioned layered product etc., it is usually desirable under a vacuum or reduced pressure to carry out on a pressure 0.2 - 1.0MPa, the temperature of 50-200 degrees C, and about [time amount 30-600 second] conditions.

[0147] Moreover, the laminating of the optical waveguide is previously carried out on the substrate, the laminating of the layered product may be carried out to this, optical waveguide is

previously formed on the resin insulating layer between layers of the outermost layer of a layered product, and the laminating of this may be carried out to a substrate.
[0148] Moreover, the micro-lens formation process which forms a micro lens in the edge of the optical path for lightwave signal transmission may be performed after laminating process termination if needed. It is because the transmission loss of a lightwave signal can be suppressed more. In order to form a micro lens in the edge of the above-mentioned optical path for lightwave signal transmission, when you may arrange in the edge of the optical path for lightwave signal transmission through the adhesives layer formed on the solder resist layer (refer to drawing 2) and the optical path for lightwave signal transmission is constituted by the resin constituent, you may form directly on this resin constituent.
[0149] As an approach of forming a micro lens directly on the above-mentioned resin constituent, optimum dose dropping of the non-hardened resin for optical lenses can be carried out on a resin constituent, and this method of performing hardening processing can be mentioned to the resin for optical lenses which is not hardened [which was dropped], for example. In the above-mentioned approach, in case optimum dose dropping of the non-hardened resin for optical lenses is carried out on a resin constituent, equipments, such as a dispenser, an ink jet, a micropipette, and a micro syringe, can be used. Moreover, since the resin for optical lenses which is not hardened [which was dropped on the resin constituent using such equipment] tends to become a globular form with the surface tension, it can become hemispherical on the above-mentioned resin constituent, and the semi-sphere-like micro lens can be formed on the resin constituent by performing hardening processing to the resin for optical lenses which is not semi-sphere-like hardened after that. As the above-mentioned resin for optical lenses, the polymer ingredient explained by the optical waveguide of the substrate for IC chip mounting of above-mentioned this inventions, such as acrylic resin and an epoxy resin, the same ingredient, etc. can be mentioned, for example. In addition, a diameter of a micro lens, a configuration of a curved surface, etc. which carry out in this way and are formed are controllable by adjusting the viscosity of the non-hardened resin for optical lenses etc. suitably, taking into consideration the wettability of a resin constituent and the non-hardened resin for optical lenses.
[0150] Moreover, by the manufacture approach of the substrate for IC chip mounting of the first this invention, the micro-lens formation process which forms a micro lens into the optical path for lightwave signal transmission may be performed. Even in this case, it is because the transmission loss of a lightwave signal can be suppressed more. In order to form a micro lens into the above-mentioned optical path for lightwave signal transmission When the optical path for lightwave signal transmission is constituted by the resin constituent and the opening, It is the interior of the above-mentioned optical path for lightwave signal transmission, and you may form directly on the above-mentioned resin constituent (refer to drawing 16), and the above-mentioned resin constituent may be made into two-layer structure depending on the case, and the above-mentioned micro lens may be formed between the upper resin constituent and a lower layer resin constituent.
[0151] As an approach of forming a micro lens into the above-mentioned optical path for lightwave signal transmission, when the optical path for lightwave signal transmission is constituted by the resin constituent and the opening, the approach of forming the micro lens which consists of resin for optical lenses in the edge of the optical path for lightwave signal transmission mentioned above, and the same approach can be mentioned. In a circuit layered product moreover, the conductor when the above-mentioned resin constituent is two-layer structure, before forming the above-mentioned solder resist layer -- After making opening for lightwave signal transmission fill up with and harden a non-hardened resin constituent, on this stiffened resin constituent The micro lens which consists of resin for optical lenses by the approach mentioned above is formed. then, the above -- a conductor -- a solder resist layer can be formed on a circuit layered product, and a micro lens can be formed between the upper resin constituent and a lower layer resin constituent by filling up with and hardening a non-hardened resin constituent to opening for optical paths of this solder resist layer.
[0152] Furthermore, the substrate for IC chip mounting of this invention can be manufactured by

forming a solder bump and mounting an optical element (a photo detector and light emitting device) in a solder resist layer. The above-mentioned solder bump's formation is performed by carrying out a reflow, after filling up the above-mentioned solder pad with soldering paste through the mask with which opening was formed in the part equivalent to the above-mentioned solder pad. Moreover, mounting of the above-mentioned optical element can be performed for example, through the above-mentioned solder bump. Moreover, for example, in case the above-mentioned solder bump is formed, when filled up with soldering paste, the optical element is attached, and an optical element may be mounted in a reflow and coincidence. Moreover, it may replace with solder and an optical element may be mounted using electroconductive glue etc. By passing through such a process, the substrate for IC chip mounting of this invention can be manufactured suitably.

[0153] Next, the manufacture approach of the substrate for IC chip mounting of the second this invention is explained. The manufacture approach of the substrate for IC chip mounting of the second this invention (a) -- a conductor -- with the optical waveguide formation process which forms optical waveguide on the substrate with which the circuit was formed (b) -- the substrate top with which the above-mentioned optical waveguide was formed -- the resin insulating layer between layers, and a conductor -- with the multilayer-interconnection plate production process which carries out laminating formation of the circuit one by one, and is used as a multilayer-interconnection plate (c) It is characterized by including the solder resist layer formation process which forms in one side of the above-mentioned multilayer-interconnection plate the solder resist layer which has opening formed at the opening formation process which forms opening used as the optical path for lightwave signal transmission, and the process of (d) above (c), and opening which was open for free passage in the above-mentioned multilayer-interconnection plate.

[0154] while forming optical waveguide in the interior of the substrate for IC chip mounting by the manufacture approach of the substrate for IC chip mounting of the second this invention -- a conductor -- opening which was open for free passage in the circuit layered product and the solder resist layer is formed. When the substrate for IC chip mounting which this opening that was open for free passage could play a role of an optical path for lightwave signal transmission, therefore was manufactured by the manufacture approach of the second this invention mounts an optical element, it can transmit a lightwave signal suitably through the optical path for lightwave signal transmission between this optical element and optical waveguide.

[0155] first, the process of the above (a), i.e., a conductor, -- the optical waveguide formation process which forms optical waveguide on the substrate with which the circuit was formed is explained in order of a process. Specifically, the above-mentioned optical waveguide can be formed by passing through the process of following the (1) - (3).

[0156] (1) an insulating substrate -- a start ingredient -- carrying out -- first -- this insulating substrate top -- a conductor -- form a circuit. As the above-mentioned insulating substrate, a glass epoxy group plate, a polyester substrate, a polyimide substrate, a bismaleimide-triazine (BT) resin substrate, a thermosetting polyphenylene ether substrate, copper clad laminate, a RCC substrate, etc. are mentioned, for example. Moreover, ceramic substrates, such as an alumimium nitride substrate, and a silicon substrate may be used.

[0157] the above -- a conductor -- a circuit can be formed by performing etching processing, after forming a solid conductor layer in the front face of for example, the above-mentioned insulating substrate by nonelectrolytic plating processing etc. Moreover, you may form by performing etching processing to copper clad laminate or a RCC substrate. moreover, the thing for which etching processing is performed -- a conductor -- forming an electroplating layer in the plating-resist agenesis section, and removing the conductor layer under plating resist and this plating resist after that, after replacing with the approach of forming a circuit and forming plating resist on a solid conductor layer -- a conductor -- the approach of forming a circuit -- using -- a conductor -- a circuit may be formed. in addition, the above -- a conductor -- a circuit may be formed after the process of (3) mentioned later.

[0158] moreover, the conductor whose above-mentioned insulating substrate was pinched -- in making connection between circuits by the through hole, after using a drill, laser, etc. for

example, for the above-mentioned insulating substrate and forming the through tube for through holes, the through hole is formed by performing nonelectrolytic plating processing etc. In addition, the diameter of the above-mentioned through tube for through holes is usually 100-300 micrometers. Moreover, when a through hole is formed, it is desirable to be filled up with a resin filler in this through hole.

[0159] (2) next, the need -- responding -- a conductor -- perform roughening formation processing on the surface of a circuit. as the above-mentioned roughening formation processing -- melanism (oxidization) -- the etching processing using the etching reagent containing - reduction processing, the second copper complex, and an organic-acid salt etc., processing by the Cu-nickel-P needlelike alloy plating, etc. can be mentioned. the case where a roughening side is formed here -- the average roughness of this roughening side -- usually -- 0.1-5 micrometers -- desirable -- a conductor -- the adhesion of a circuit and the resin insulating layer between layers, and a conductor -- when the effect to the electrical signal transmission ability of a circuit etc. is taken into consideration, 2-4 micrometers is more desirable. In addition, before this roughening formation processing is filled up with a resin filler in a through hole, it may be performed, and it may form a roughening side also in the wall surface of a through hole. It is because the adhesion of a through hole and a resin filler improves.

[0160] (3) next, the conductor on a substrate -- form optical waveguide in the circuit agenesis section. When forming the organic system optical waveguide which consists of a polymer ingredient etc. as optical waveguide, beforehand, the optical waveguide fabricated in the shape of a film on the mold releasing film etc. can be stuck on a substrate, or optical waveguide can be formed from forming directly on a substrate. Specifically, it can form using a selective polymerization method, the approach using reactive ion etching and photolithography, the direct exposing method, the approach using injection molding, the photograph breeching method, the approach that combined these. In addition, these approaches can be used also when forming directly it forms on a substrate also when forming optical waveguide on a mold releasing film etc. Moreover, when forming the inorganic system optical waveguide which consists of quartz glass, a compound semiconductor, etc. as optical waveguide, it can carry out by making the inorganic material of LiNbO3 and LiTaO3 grade form by the liquid-phase-epitaxial method, the chemistry depositing method (CVD), a molecular beam epitaxy, etc., or attaching beforehand inorganic system optical waveguides, such as quartz glass fabricated in the predetermined configuration, through adhesives.

[0161] Moreover, an optical-path conversion mirror is formed in the above-mentioned optical waveguide. Although it may be formed before the above-mentioned optical-path conversion mirror attaches optical waveguide on the resin insulating layer between layers, and it may be formed after attaching it on a substrate, it is desirable to form an optical-path conversion mirror beforehand except for the case where this optical waveguide is directly formed on a substrate. other members which can work easily and constitute the substrate for IC chip mounting at the time of an activity, for example, a conductor, -- it is because a blemish is attached to a circuit, a substrate, etc. or there is no possibility of damaging these. The approach used as an approach of forming the above-mentioned optical-path conversion mirror by (B) optical waveguide production process in the manufacture approach of the substrate for IC chip mounting of the first this invention, the same approach, etc. can be used.

[0162] moreover, the insulation substrate top as mentioned above, after forming optical waveguide at this process of (3) -- a conductor -- the approach of forming a circuit, forming an electrolysis plating layer in the plating-resist agenesis section after forming plating resist on a solid conductor layer in this case, and removing the solid conductor layer under plating resist and this plating resist further -- a conductor -- it is desirable to form a circuit. This is because there are few possibilities of damaging the formed optical waveguide.

[0163] next, the substrate top with which optical waveguide was formed at the process of the above (b), i.e., the process of the above (a), -- the resin insulating layer between layers, and a conductor -- the multilayer-interconnection plate production process which carries out the laminating of the circuit one by one, and is used as a multilayer-interconnection plate is explained in order of a process. Specifically, a multilayer-interconnection plate can be

manufactured by passing through the process of following the (1) - (7).
[0164] (1) Form the resin layer which forms the resin layer which is not hardened [which some of thermosetting resin, photopolymers, and thermosetting resin become from the acrylic-ized resin, these and thermoplastics, and the included resin complex] on the substrate with which optical waveguide was formed at the process of the above (a), or consists of thermoplastics. (a) -- a conductor -- the resin used in case the resin insulating layer between layers is formed with a circuit layered product formation process, the same resin, etc. can be used. [in / specifically / the manufacture approach of the substrate for IC chip mounting of the first this invention] The resin layer which is not hardened [above-mentioned] can be formed by applying non-hardened resin by the roll coater, a curtain coating machine, etc., or carrying out thermocompression bonding of the resin film non-hardened (semi-hardening). Moreover, the resin layer which consists of the above-mentioned thermoplastics can be formed by carrying out thermocompression bonding of the resin Plastic solid fabricated on the film.
[0165] Thermocompression bonding of the above-mentioned resin complex or a resin Plastic solid can be performed for example, using a vacuum laminator etc. Moreover, although what is necessary is not to limit especially sticking-by-pressure conditions, but just to choose suitably in consideration of the presentation of a resin film etc., it is usually desirable to carry out on a pressure 0.25 - 1.0MPa, the temperature of 40-70 degrees C, the degree of vacuum of 13-1300Pa, and about [time amount 10-120 second] conditions.
[0166] (2) Next, in forming the resin insulating layer between layers using thermosetting resin and resin complex as the ingredient, while performing hardening processing to a non-hardened resin insulating layer, form opening for the Bahia halls and consider as the resin insulating layer between layers. Moreover, at this process, the through tube for through holes may be formed if needed. As for the above-mentioned opening for the Bahia halls, forming by the lasing is desirable. Moreover, when a photopolymer is used as an ingredient of the resin insulating layer between layers, you may form by the exposure development.
[0167] Moreover, in forming the resin insulating layer between layers using thermoplastics as the ingredient, opening for the Bahia halls is formed in the resin layer which consists of thermoplastics, and it considers as the resin insulating layer between layers. In this case, opening for the Bahia halls can be formed by giving the lasing. Moreover, what is necessary is just to form this through tube for through holes by drilling, the lasing, etc., when forming the through tube for through holes at this process.
[0168] (a) -- a conductor -- in a circuit layered product formation process, the same thing as the laser used in case opening for the Bahia halls is formed etc. is mentioned. [in / for example / as laser used for the above-mentioned lasing / the manufacture approach of the substrate for IC chip mounting of the first this invention]
[0169] (3) next, the front face of the resin insulating layer between layers including the wall of opening for the Bahia halls -- a conductor -- form a circuit. (a) -- a conductor -- the approach of using by (5) - (7) of a circuit layered product formation process, the same approach, etc. can be used. [in / specifically / the manufacture approach of the substrate for IC chip mounting of the first this invention] moreover, this process -- also setting -- the above (a) -- a conductor -- when a through hole may be formed and a through hole is formed like a circuit layered product formation process, it may be filled up with a resin filler in this through hole. Moreover, when filled up with a resin filler in a through hole, a wrap lid plating layer may be formed for a resin filler layer with nonelectrolytic plating etc.
[0170] (4) Next, when a lid plating layer is formed, if needed, perform roughening processing on the front face of this lid plating layer, and form the resin insulating layer between layers by repeating the above (1) and the process of (2) further. In addition, a through hole may be formed and it is not necessary to form at this process.
(5) -- repeating the above (3) and the process of (4) further if needed -- a conductor -- laminating formation of a circuit and the resin insulating layer between layers may be carried out.

[0171] performing the process of such (1) - (5) -- both sides of a substrate -- a conductor -- a circuit and the resin insulating layer between layers can manufacture the multilayer-

interconnection plate by which laminating formation was carried out. in addition, the manufacture approach of the multilayer-interconnection plate explained in full detail here -- semi ADITEBU -- the manufacture approach of the multilayer-interconnection plate manufactured at the process of the above (a) although it is law -- semi ADITEBU -- it limits to law -- not having -- full ADITEBU -- it can also carry out using law, a subtractive process, a package laminated layers method, the conformal method, etc. a conductor detailed in these -- semi ADITEBU from a point which is excellent as an approach of forming a circuit -- law and full ADITEBU -- ADITEBU of law -- law is desirable.

[0172] By the manufacture approach of the substrate for IC chip mounting of the second this invention, after manufacturing a multilayer-interconnection plate through the process of the above (a) and the above (b), the process of the above (c), i.e., the opening formation process which forms opening used as the optical path for lightwave signal transmission in the above-mentioned multilayer-interconnection plate, is performed. Opening formed at this process will play the role of the optical path for lightwave signal transmission which connects an optical element and optical waveguide in the substrate for IC chip mounting. Therefore, opening formed at this process is hereafter called opening for lightwave signal transmission.

[0173] The lasing etc. performs formation of the above-mentioned opening for lightwave signal transmission. The same thing as the laser used in formation of the above-mentioned opening for the Bahia halls as laser used in the above-mentioned lasing etc. is mentioned. In this case, it is desirable to use the laser of the wavelength in which the above-mentioned optical waveguide does not have absorption as the above-mentioned laser. It is because there are few possibilities of damaging the above-mentioned optical waveguide front face at the time of the above-mentioned opening formation for lightwave signal transmission. especially the formation location of the above-mentioned opening for lightwave signal transmission is limited -- not having -- a conductor -- what is necessary is just to choose suitably in consideration of the mounting position of the design of a circuit, and IC chip etc. Moreover, as for the above-mentioned opening for lightwave signal transmission, it is desirable to form for every optical elements, such as a photo detector and a light emitting device. Moreover, you may form for every signal wave length.

[0174] Moreover, after forming opening for lightwave signal transmission, DESUMIA processing may be performed to the wall surface of opening for lightwave signal transmission if needed. The above-mentioned DESUMIA processing can be performed using processing for example, by the permanganic acid solution, plasma treatment, corona treatment, etc. In addition, by performing the above-mentioned DESUMIA processing, the resin remainder in opening for lightwave signal transmission, weld flash, etc. can be removed, and the transmission loss resulting from the scattered reflection in the wall surface of the optical path for lightwave signal transmission can be reduced.

[0175] Moreover, after the opening formation for lightwave signal transmission, before forming a conductor layer or filling up a non-hardened resin constituent with the following process, it is desirable to perform the roughening side formation process which makes a roughening side the wall surface of opening for lightwave signal transmission if needed. It is because adhesion with a conductor layer or a resin constituent can be raised. Formation of the above-mentioned roughening side can be performed by dissolving the part exposed with oxidizers, such as acid; chromic acids, such as a sulfuric acid, a hydrochloric acid, and a nitric acid, chromate acid mixture, and a permanganate, etc. when openings for lightwave signal transmission, such as a resin insulating layer between layers, were formed. Moreover, plasma treatment, corona treatment, etc. can also perform. The average roughness (Ra) of the above-mentioned roughening side has desirable 0.5-5 micrometers, and its 1-3 micrometers are more desirable. if it is this range, it excels in adhesion with a conductor layer or a resin constituent -- it is both because it does not have a bad influence on transmission of a lightwave signal.

[0176] After forming the above-mentioned opening for lightwave signal transmission, it is desirable to perform the conductor-layer formation process which forms a conductor layer in the wall surface of the above-mentioned opening for lightwave signal transmission if needed. Formation of the above-mentioned conductor layer can be performed by approaches, such as

nonelectrolytic plating and sputtering. After forming opening for lightwave signal transmission, a catalyst nucleus can be given to the wall surface of this opening for lightwave signal transmission, and, specifically, the approach immersed in a nonelectrolytic plating bath in the substrate with which opening for lightwave signal transmission was formed can be used after that. Moreover, the conductor layer which consists of more than two-layer combining nonelectrolytic plating or sputtering may be formed, and the conductor layer which performs electrolysis plating and consists of more than two-layer may be formed after nonelectrolytic plating or sputtering.

[0177] in such a conductor-layer formation process, while forming a conductor layer in the wall surface of the above-mentioned opening for lightwave signal transmission, pass the process of the above (b) -- the formed resin insulating-layer top between layers -- the conductor of the outermost layer -- it is desirable to form a circuit. First, in case a conductor layer is formed in the wall surface of opening for lightwave signal transmission with nonelectrolytic plating etc., specifically, a conductor layer is formed also in the whole front face of the resin insulating layer between layers.

[0178] Next, plating resist is formed on the conductor layer formed in this resin insulating-layer front face between layers. What is necessary is for formation of plating resist to carry out adhesion installation of the photo mask which consists of a glass substrate with which the plating resist pattern was drawn, and just to perform it by performing an exposure development, after sticking for example, a photosensitive dry film.

[0179] furthermore, the conductor which became independent on the resin insulating layer between layers by performing electrolysis plating by making into a plating bar the conductor layer formed on the above-mentioned resin insulating layer between layers, forming an electrolysis plating layer in the above-mentioned plating-resist agenesis section, and removing the conductor layer under the above-mentioned plating resist and this plating resist after that -- a circuit is formed.

[0180] Moreover, a roughening side may be formed in the wall surface of the above-mentioned conductor layer after forming the above-mentioned conductor layer. formation of the above-mentioned roughening side -- for example, melanism (oxidization) -- it can carry out using the etching processing using the etching reagent containing - reduction processing, the second copper complex, and an organic-acid salt etc., processing by the Cu-nickel-P needlelike alloy plating, etc.

[0181] Moreover, after forming the above-mentioned opening for lightwave signal transmission, it is desirable to carry out like the resin packer who fills up this opening with a non-hardened resin constituent if needed. After being filled up with a non-hardened resin constituent, the optical path for lightwave signal transmission which consists of a resin constituent and an opening, or the optical path for lightwave signal transmission which consists of resin constituents can be formed by performing hardening processing. It is not limited especially as the restoration approach of the resin constituent which is not hardened [concrete], for example, approaches, such as printing and potting, can be used. In addition, when filled up with a non-hardened resin constituent by printing, a non-hardened resin constituent may be printed at once and may be printed in 2 steps or more.

[0182] Moreover, in case it is filled up with a non-hardened resin constituent, it may be filled up with the resin constituent which is not hardened [of somewhat many amounts], and the excessive resin constituent with which it overflowed from opening for lightwave signal transmission may be removed from the inner product of the above-mentioned opening for lightwave signal transmission after restoration termination. the above -- polish etc. can perform removal of an excessive resin constituent. Moreover, what is necessary is for the condition of a resin constituent to be in a semi-hardening condition, to be in the condition hardened completely, and just to choose it suitably in consideration of the ingredient of a resin constituent etc., when removing an excessive resin constituent. In addition, when not carrying out like the above-mentioned resin constituent packer, the optical path for lightwave signal transmission which consists of openings can be formed.

[0183] A part of optical path for lightwave signal transmission can be formed in the multilayer-

interconnection plate manufactured through the process of the above (a) and the above (b) by passing like such an opening formation process, the roughening side formation process performed if needed, a conductor-layer formation process, and a resin constituent packer. moreover, the conductor which became independent by forming a conductor layer also in the front face of the resin insulating layer between layers, and performing processing mentioned above in case the above-mentioned conductor-layer formation process is performed -- a circuit can be formed. of course, the approach which mentioned the above-mentioned conductor layer above even if it was the case where a formation process was not performed -- the front face of the resin insulating layer between layers -- a conductor -- a circuit can be formed.

[0184] Next, the solder resist layer formation process which forms in one side of the above-mentioned multilayer-interconnection plate the solder resist layer which has opening which was open for free passage to opening formed at the process of the above (d), i.e., the process of the above (c), is performed. Specifically, a solder resist layer can be formed by performing following (1) and the process of (2).

[0185] (1) Form the layer of a solder resist constituent in the outermost layer of the multilayer-interconnection plate in which opening for lightwave signal transmission was formed, first. The layer of the above-mentioned solder resist constituent can be formed by the approach of using with (c) solder resist layer formation process of the manufacture approach of the first this invention, and the same approach.

[0186] (2) Next, form in the layer of the above-mentioned solder resist constituent opening (henceforth opening for optical paths) which was open for free passage to the above-mentioned opening for lightwave signal transmission. Specifically, it can form by the exposure development, the lasing, etc. Moreover, in case the above-mentioned opening for optical paths is formed, it is desirable to form opening for solder bump formation in coincidence. In addition, formation and formation of the above-mentioned opening for solder bump formation are [opening / above-mentioned / for optical paths] separately good in a line. Moreover, in case a solder resist layer is formed, the solder resist layer which has opening for optical paths and opening for solder bump formation may be formed by producing the resin film which has opening in a desired location, and sticking this resin film on it beforehand.

[0187] Moreover, the path of the cross section of the above-mentioned opening for optical paths may be smaller than the path of the cross section of the above-mentioned opening for lightwave signal transmission. In this case, what is necessary is just to make the path of the cross section of the above-mentioned optical-path opening smaller 20-100 micrometers than the path of the cross section of the above-mentioned opening for lightwave signal transmission.

[0188] By passing through such a process of (1) and (2), the solder resist layer which has this opening for lightwave signal transmission and opening which was open for free passage can be formed on the multilayer-interconnection plate with which opening for lightwave signal transmission was formed.

[0189] Moreover, when a non-hardened resin constituent is filled up with the opening formation process of the above (c) into opening for lightwave signal transmission, a non-hardened resin constituent may be filled up with the same approach as the above-mentioned opening for lightwave signal transmission into opening for optical paths formed in the above-mentioned solder resist layer. Thus, after filling up opening for optical paths of a solder resist layer with a non-hardened resin constituent, the optical path for lightwave signal transmission which consists of resin constituents can be formed by performing hardening processing of the resin constituent which is not hardened [this]. In addition, although the solder resist layer which has opening which was open for free passage to the above-mentioned opening for optical paths will be formed in the opening formation side for lightwave signal transmission of one side of a multilayer-interconnection plate, i.e., a multilayer-interconnection plate, it may form in the field of another side of a multilayer-interconnection plate the solder resist layer which does not have opening.

[0190] Moreover, after forming the above-mentioned opening for lightwave signal transmission, and the above-mentioned opening for optical paths, it is desirable to perform the edge of the optical path for lightwave signal transmission and the micro-lens formation process which forms

a micro lens into the optical path for lightwave signal transmission if needed. It is because the transmission loss of a lightwave signal can be suppressed more. In order to form a micro lens into the edge of the above-mentioned optical path for lightwave signal transmission, or the optical path for lightwave signal transmission, the approach explained by the manufacture approach of the substrate for IC chip mounting of the first this invention and the same approach can be used.

[0191] By the manufacture approach of the substrate for IC chip mounting of the second this invention, after performing the process of such (a) - (d), the substrate for IC chip mounting can be manufactured by performing formation of a solder pad or a solder bump, and mounting of an optical element using the following approach. Formation of a solder pad or a solder bump and mounting of an optical element can be performed by the manufacture approach of the substrate for IC chip mounting of the first this invention, and the same approach.

[0192] In addition, by the manufacture approach of the substrate for IC chip mounting of the first and the second this invention, optical waveguide is formed between a substrate and the resin insulating layer between layers. However, the formation location of the optical waveguide in the substrate for IC chip mounting of this invention may not be limited between a substrate and the resin insulating layer between layers, and may be between the resin insulating layers between layers. such a substrate for IC chip mounting of a configuration -- for example, the manufacture approach of the substrate for IC chip mounting of the second this invention -- setting -- the process, i.e., the optical waveguide formation process, of (a) -- optical waveguide -- not forming -- the process, i.e., the multilayer-interconnection plate production process, of (b) -- the resin insulating layer between layers, and a conductor -- after carrying out laminating formation of the circuit, it can manufacture by forming optical waveguide.

[0193]

[Example] Hereafter, this invention is further explained to a detail.

(Example 1)

A. The production bisphenol A mold epoxy resin (weight-per-epoxy-equivalent 469, Epicoat 1001 by oil-ized shell epoxy company) 30 weight section of a resin film, The cresol novolak mold epoxy resin (weight-per-epoxy-equivalent 215, Epiclon N-673 by Dainippon Ink & Chemicals, Inc.) 40 weight section, The triazine structure content phenol novolak resin (phenol nature hydroxyl equivalent 120, Dainippon Ink & Chemicals, Inc. make FENO light KA-7052) 30 weight section The ethyl diethylene glycol acetate 20 weight section, The heating dissolution is carried out stirring in the solvent naphtha 20 weight section. There The end epoxidation polybutadiene rubber (Nagase Brothers formation DENAREKKUSU R-45 by industrial company EPT) 15 weight section, and the 2-phenyl -4, the 5-screw (hydroxymethyl) imidazole grinding article 1.5 weight section, The pulverizing silica 2 weight section and the silicon system defoaming agent 0.5 weight section were added, and the epoxy resin constituent was prepared. After applying using a roll coater so that the thickness after drying the obtained epoxy resin constituent on a PET film with a thickness of 38 micrometers may be set to 50 micrometers, the resin film was produced by making it dry for 10 minutes at 80-120 degrees C.

[0194] The mean particle diameter by which coating of the silane coupling agent was carried out to the preparation bisphenol female mold epoxy monomer (oil-ized shell company make, molecular weight : 310 YL983U) 100 weight section of the resin constituent for through tube restoration and a front face B. By 1.6 micrometers the diameter of grain of maximum size -- SiO2 spherical particle (the Adtec Corp. make --) 15 micrometers or less CRS The viscosity prepared the resin filler of 45 - 49 Pa-s at 23**1 degree C by carrying out stirring mixing of the 1101-CE170 weight section and the leveling agent (Sannopuko PERENORU S4) 1.5 weight section for a container. In addition, the imidazole curing agent (Shikoku formation shrine make, 2E4 MZ-CN) 6.5 weight section was used as a curing agent.

[0195] C. As a substrate substrate, the insulating substrate which consists of a glass epoxy resin with a thickness of 0.8mm or BT (bismaleimide triazine) resin was used.

[0196] D. The optical waveguide which has an optical-path conversion mirror using manufacture, next the following approaches of optical waveguide was manufactured. That is, the tip formed 45-degree optical-path conversion mirror in the end of the optical waveguide (micro parts

company make : 20 micrometers in width of face of 1mm, thickness) of the shape of a film which consists of PMMA using the diamond saw which is 90 degrees of V types, and manufactured optical waveguide at it.
[0197] E. The copper-clad resin film which 18-micrometer copper foil 28 laminates to both sides of the base material layer 31 which was made to carry out heat curing of the resin film indicated to the manufacture (1) above A of a layered product for 30 minutes, and formed it at 170 degrees C was used as the start ingredient (refer to drawing 3 (a)). first, the thing which laser drilling of this copper-clad resin film is carried out, and nonelectrolytic plating processing is performed, and is etched in the shape of a pattern -- both sides of the base material layer 31 -- a conductor -- the circuit 24 and the through hole 29 were formed.
[0198] (2) Wash in cold water the base material layer in which the circuit 24 was formed. a through hole 29 and a conductor -- NaOH (10 g/l), NaClO2 after drying (40 g/l), Melanism processing the water solution containing Na3PO4 (6 g/l) -- melanism -- it considers as a bath (oxidation bath) -- and the conductor which performs reduction processing which makes a reduction bath NaOH (10 g/l) and the water solution containing NaBH4 (6 g/l), and includes a through hole 29 -- the roughening side (not shown) was formed in the front face of a circuit 24 (refer to drawing 3 (b)).
[0199] (3) the following approach after preparing the resin filler indicated to Above B -- after preparation -- less than 24 hours -- the conductor of one side of the inside of a through hole 29, and the base material layer 31 -- the circuit agenesis section and a conductor -- the layer of resin filler 30' was formed in the rim section of a circuit 24. That is, after pushing in a resin filler in a through hole using a squeegee, it was made to dry on 100 degrees C and the conditions for 20 minutes first. next, a conductor -- the conductor with which the part equivalent to the circuit agenesis section lays the mask which carried out opening on a base material layer, and serves as a crevice using the squeegee -- the circuit agenesis section was also filled up with the resin filler, and the layer of resin filler 30' was formed by making it dry on 100 degrees C and the conditions for 20 minutes (refer to drawing 3 (c)).
[0200] (4) the belt sander [one side / which finished processing of the above (3) / of a base material layer] polish using the belt abrasive paper (Sankyo Rikagaku make) of **600 -- a conductor -- it ground so that resin filler 30' might remain neither in the front face of a circuit 24, nor the land front face of a through hole 29, and subsequently buffing for removing the blemish by the above-mentioned belt sander polish was performed. Such a series of polishes were similarly performed about the field of another side of a base material layer. Subsequently, by 100 degrees C, it performed at 150 degrees C for 1 hour for 3 hours, 120 degrees C performed heat-treatment of 7 hours at 180 degrees C for 1 hour, and the resin filler layer 30 was formed.
[0201] thus, a through hole 29 and a conductor -- the surface section of the resin filler 30 formed in the circuit agenesis section, and a conductor -- the front face of a circuit 24 -- flattening -- carrying out -- the resin filler 30 and a conductor -- the base material layer which the side face of a circuit 24 stuck firmly through the roughening side (not shown), and the internal surface and the resin filler 30 of a through hole 29 stuck firmly through the roughening side (not shown) was obtained (refer to drawing 3 (d)). this process -- the front face of the resin filler layer 30, and a conductor -- the front face of a circuit 24 turns into the same flat surface.
[0202] (5) software etching after rinsing and carrying out acid cleaning of the above-mentioned base material layer -- carrying out -- subsequently -- an etching reagent -- both sides of a substrate -- a spray -- spraying -- a conductor -- etching the front face of a circuit 24, and the land front face of a through hole 29 -- a conductor -- the roughening side (not shown) was formed in all the front faces of a circuit 24. As an etching reagent, the etching reagent (the product made from MEKKU, MEKKU dirty bond) containing the imidazole copper (II) complex 10 weight section, the glycolic-acid 7 weight section, and the potassium chloride 5 weight section was used.
[0203] (6) Next, the somewhat larger resin film than the base material layer produced by Above A was laid on the base material layer, and after carrying out temporary sticking by pressure and judging on pressure 0.4MPa, the temperature of 80 degrees C, and the conditions for sticking-

by-pressure time amount 10 seconds, the resin insulating layer 22 between layers was formed by sticking using vacuum laminator equipment by the approach of further the following (refer to drawing 3 (e)). That is, on the base material layer, actual sticking by pressure was carried out on the degree of vacuum of 65Pa, pressure 0.4MPa, temperature 80, and the conditions for time amount 60 seconds, and heat curing of the resin film was carried out for 30 minutes at 170 degrees C after that.

[0204] (7) Next, the opening 26 for the Bahia halls with a diameter of 80 micrometers was formed in the resin insulating layer 22 between layers by CO2 gas laser with a wavelength of 10.4 micrometers through the mask with which the through tube with a thickness of 1.2mm was formed on the resin insulating layer 22 between layers on the beam diameter of 4.0mm, the Top Hat mode, 8.0 microseconds of pulse width, the path of 1.0mm of the through tube of a mask, and the conditions of one shot (refer to drawing 4 (a)).

[0205] (8) The roughening side (not shown) was formed in the front face containing the internal surface of the opening 26 for the Bahia halls by immersing the base material layer in which the opening 26 for the Bahia halls was formed, for 10 minutes in the 80-degree C solution containing the permanganic acid of 60 g/l, and carrying out dissolution removal of the epoxy resin particle which exists in the front face of the resin insulating layer 22 between layers.

[0206] (9) Next, the base material layer which finished the above-mentioned processing was washed in cold water after being immersed in the neutralization solution (product made from SHIPUREI). Furthermore, the catalyst nucleus was made for the front face of the base material layer which carried out the surface roughening process (a roughening depth of 3 micrometers) to adhere to the front face (for the internal surface of the opening 26 for the Bahia halls to be included) of the resin insulating layer 22 between layers by giving a palladium catalyst (not shown). That is, the above-mentioned base material layer was immersed into the catalytic liquid containing a palladium chloride (PdCl2) and a stannous chloride (SnCl2), and the catalyst was given by depositing a palladium metal.

[0207] (10) Next, into the non-electrolytic copper plating water solution of the following presentations, the base material layer was immersed and the thin film conductor layer (non-electrolytic copper plating film) 32 with a thickness of 0.6-3.0 micrometers was formed on the front face (the internal surface of the opening 26 for the Bahia halls is included) of the resin insulating layer 22 between layers (refer to drawing 4 (b)).

[Nonelectrolytic plating water solution]

NiSO4 0.003 mol/l tartaric acid 0.200 mol/l copper sulfate 0.030 mol/lHCHO 0.050 mol/lNaOH 0.100 mol/lalpha and alpha'-bipyridyl 100 mg/l polyethylene glycol (PEG) 0.10 g/l [nonelectrolytic plating conditions]

It is 40 minutes [0208] by whenever [30-degree C solution temperature]. (11) Next, the plating resist 23 with a thickness of 20 micrometers was formed by sticking a commercial photosensitive dry film on the base material layer in which the thin film conductor layer (non-electrolytic copper plating film) 32 was formed, laying a mask, exposing by 100 mJ/cm2, and carrying out a development in a sodium-carbonate water solution 0.8% (refer to drawing 4 (c)).

[0209] (12) Subsequently, 50-degree C water washed the base material layer, and it degreased, with 25-degree C water, after washing with the sulfuric acid further after rinsing, electrolysis plating was performed on condition that the following, and the electrolytic copper plating film 33 with a thickness of 20 micrometers was formed in the plating-resist 23 agenesis section (refer to drawing 4 (d)).

[Electrolysis plating liquid]

Sulfuric acid 2.24 mol/l copper sulfate 0.26 mol/l additive 19.5 ml/l (made in ATOTEKKU Japan, KAPARASHIDO HL)

[Electrolysis plating conditions]

Current density 1 A/dm 2 hours 65 Part temperature 22**2 ** [0210] (13) -- a conductor with a thickness of 18 micrometers which carries out etching processing of the thin film conductor layer under the plating resist 23 with the mixed liquor of a sulfuric acid and a hydrogen peroxide, carries out dissolution removal and consists of a thin film conductor layer (non-electrolytic copper plating film) 32 and electrolytic copper plating film 33 further after carrying out exfoliation

removal of the plating resist 23 by NaOH 5% -- the circuit 25 (the Bahia hall 27 is included) was formed (refer to drawing 5 (a)).
[0211] A roughening side (not shown) is formed in the front face of a circuit 25. (14) -- the still more nearly same etching reagent as the etching reagent used at the process of the above (5) -- using -- a conductor -- subsequently the resin insulating layer 22 between layers which has the opening 26 for the Bahia halls like the process of above-mentioned (6) - (8) and by which the roughening side (not shown) was formed in the front face -- laminating formation -- carrying out -- a conductor -- it considered as the circuit layered product (refer to drawing 5 (b)). Then, the opening 46 with a diameter of 250 micrometers which penetrates the base material layer 31 and the resin insulating layer 22 between layers using carbon dioxide gas laser was formed through the mask with which the through tube with a thickness of 1.2mm was formed on the resin insulating layer 22 between layers, and DESUMIA processing was further performed to the wall surface of opening 46 (refer to drawing 5 (c)).
[0212] (15) Next, give a catalyst to the wall surface of opening 46, and the front face of the resin insulating layer 22 between layers by the approach used at the process of the above (9), and the same approach. Furthermore, in the nonelectrolytic plating liquid used at the process of the above (10), and the same non-electrolytic copper plating water solution a conductor -- the circuit layered product was immersed and the thin film conductor layer (non-electrolytic copper plating film) 32 was formed in the front face (the internal surface of the opening 26 for the Bahia halls is included) of the resin insulating layer 22 between layers, and the wall surface of opening 46 (refer to drawing 6 (a)).
[0213] (16) Next, plating resist 23 was formed in the part on a thin film conductor layer by the approach used at the process of the above (11), and the same approach, and the electrolytic copper plating film 33 with a thickness of 20 micrometers was further formed in the plating-resist 23 agenesis section by the approach used at the process of the above (12), and the same approach (refer to drawing 6 R> 6 (b)).
[0214] (17) next, the approach used at the process of the above (13) and the same approach -- the part on a thin film conductor layer -- exfoliation of plating resist 23, and removal of the thin film conductor layer under plating resist 23 -- carrying out -- a conductor -- the circuit 25 (the Bahia hall 27 is included) and the conductor layer 45 were formed. furthermore, the approach used at the process of the above (2) and the same approach -- oxidation reduction processing -- carrying out -- a conductor -- the front face of a circuit 25 and the front face of a conductor layer 45 were made into the roughening side (not shown) (refer to drawing 6 (c)).
[0215] (18) Next, after being filled up with the resin constituent containing an epoxy resin and making it dry in the opening 46 in which the conductor layer 45 was formed using a squeegee, flattening of the surface was carried out by buffing. Furthermore, hardening processing was performed and resin constituent layer 42a was formed (refer to drawing 7 (a)).
[0216] (19) Next, made it dissolve so that it may become 60% of the weight of concentration to diethylene-glycol wood ether (DMDG). The oligomer (molecular weight: 4000) 46.67 weight section of the photosensitive grant which acrylic-ized 50% of epoxy groups of a cresol novolak mold epoxy resin (Nippon Kayaku Co., Ltd. make), 80% of the weight of the bisphenol A mold epoxy resin (oil-ized shell company make --) dissolved in the methyl ethyl ketone trade name: -- the Epicoat 1001 15.0 weight section and an imidazole curing agent (Shikoku -- formation -- shrine make --) trade name: -- 2 organic-functions acrylic monomer (the Nippon Kayaku Co., Ltd. make --) which are the 2E4 MZ-CN1.6 weight section and a photosensitive monomer trade name: -- the R604 4.5 weight section -- the same -- a multiple-valued acrylic monomer (the Kyoei Kagaku K.K. make --) trade name: -- the DPE6A1.5 weight section and a dispersed system defoaming agent (the Sannopuko make --) Stir the S-65 0.71 weight section for a container, mix, and a mixed constituent is prepared. The solder resist constituent which adjusted viscosity to 2.0 Pa-s at 25 degrees C was obtained by adding the benzophenone (Kanto chemistry company make) 2.0 weight section and the Michler's-ketone (Kanto chemistry company make) 0.2 weight section as a photosensitizer as a photopolymerization initiator to this mixed constituent. In addition, in the case of 60min-1 (rpm), in the case of rotor No.4 and 6min-1 (rpm), measurement of viscosity was based on rotor No.3 by the Brookfield viscometer (the

Tokyo Keiki Co., Ltd. make, DVL-B mold).
[0217] (20) next, the conductor in which resin constituent layer 42a was formed -- the above-mentioned solder resist constituent was applied by the thickness of 30 micrometers, for 20 minutes was performed at 70 degrees C, desiccation processing was performed on one side of a circuit layered product the condition for 30 minutes at 70 degrees C, and layer 34' of a solder resist constituent was formed in it (refer to drawing 7 (b)).
[0218] (21) Subsequently, the photo mask with a thickness of 5mm with which the pattern of opening for solder bump formation and opening for optical paths was drawn was stuck to layer 34' of the solder resist constituent by the side of IC chip mounting, it exposed by the ultraviolet rays of 1000 mJ/cm2, the development was carried out with the DMTG solution, and opening with a diameter of 200 micrometers was formed. Furthermore, it carries out at 120 degrees C for 1 hour for 1 hour, heat-treats [80 degrees C / 1 hour and 100 degrees C] on the conditions of 3 hours by 150 degrees C, respectively, the layer of a solder resist constituent is stiffened, it has the opening 47 for solder bump formation, and opening 42b for optical paths, and the solder resist layer 34 the thickness of whose is 20 micrometers was formed. In addition, a commercial solder resist constituent can also be used as the above-mentioned solder resist constituent.
[0219] (22) next, the conductor in which the solder resist layer 34 was formed -- the circuit layered product was immersed in the non-electrolyzed nickel-plating liquid of pH=4.5 containing a nickel chloride (2.3x10-1 mol/l), sodium hypophosphite (2.8x10 to 1 mol/l.), and a sodium citrate (1.6x10-1 mol/l) for 20 minutes, and the nickel-plating layer with a thickness of 5 micrometers was formed in the opening 47 for solder bump formation. The substrate Furthermore, a gold cyanide potassium (7.6x10-3 mol/l), An ammonium chloride (1.9x10-1 mol/l), a sodium citrate (1.2x10-1 mol/l), It was immersed in the non-electrolyzed gilding liquid containing sodium hypophosphite (1.7x10-1 mol/l) for 7.5 minutes on 80-degree C conditions, the gilding layer with a thickness of 0.03 micrometers was formed on the nickel-plating layer, it considered as the solder pad 36, and the layered product was obtained (refer to drawing 8 (a)).
[0220] F. Laminating process (1) The optical waveguide 50 which uses the following approaches for the position of the solder resist layer agenesis side (the inside of drawing, inferior surface of tongue) of a layered product which manufactured at the process of Above E first, and has an optical-path conversion mirror was stuck (refer to drawing 8 (b)). namely, the optical waveguide manufactured at the process of Above D -- a conductor -- it stuck so that the side face of the other end by the side of optical conversion mirror agenesis and the side face of the resin insulating layer between layers might be equal to the circuit agenesis section. In addition, attachment of optical waveguide applies to 10 micrometers in thickness the adhesives which become an adhesion side with the resin insulating layer between layers of this optical waveguide from thermosetting resin, and was performed after sticking by pressure by making it harden at 60 degrees C for 1 hour.
(2) next, the conductor of one side in which the solder resist layer is not formed in the Bahia hall 27 within 24 hours after preparation by the following approach after preparing the resin filler indicated to Above B -- the circuit agenesis section, the optical waveguide agenesis section, and a conductor -- the layer of a resin filler was formed in the rim section of a circuit 25 (it contains Bahia hall 27). That is, after pushing in a resin filler in the Bahia hall using a squeegee, it was made to dry on 100 degrees C and the conditions for 20 minutes first. next, a conductor -- the conductor with which the part equivalent to a circuit and the optical waveguide agenesis section lays the mask which carried out opening on a layered product, and serves as a crevice using the squeegee -- the circuit agenesis section was also filled up with the resin filler, and the layer of a resin filler was formed by making it dry on 100 degrees C and the conditions for 20 minutes.
[0221] (3) the belt sander [one side / of the layered product which finished processing of the above (2)] polish using the belt abrasive paper (Sankyo Rikagaku make) of **600 -- a conductor -- it ground so that a resin filler might remain neither in the front face of a circuit 25, nor the front face of optical waveguide 50, and subsequently buffing for removing the blemish by the above-mentioned belt sander polish was performed. Subsequently, by 100 degrees C, it performed at 150 degrees C for 1 hour for 3 hours, 120 degrees C performed heat-treatment of 7 hours at 180 degrees C for 1 hour, and the resin filler layer 51 was formed.

[0222] thus, the Bahia hall 27 and a conductor -- the surface section of the resin filler 51 formed in a circuit and the optical waveguide agenesis section -- The side face of a circuit 25 sticks firmly through a roughening side (not shown). a conductor -- the front face of a circuit 25 and optical waveguide 50 -- flattening -- carrying out -- the resin filler 51 and a conductor -- Moreover, the layered product which the internal surface and the resin filler 51 of the Bahia hall 27 stuck firmly through the roughening side (not shown) was obtained (refer to drawing 9 (a)). this process -- the front face of the resin filler layer 51, and a conductor -- the front face of a circuit 24 and optical waveguide 50 turns into the same flat surface.
[0223] (4) Next, lay the layered product in which optical waveguide 50 and the resin filler layer 51 were formed on the substrate 21 of Above C through the process of above-mentioned (1) - (3). Using vacuum laminator equipment, it was stuck by pressure under a vacuum or reduced pressure on pressure 0.5MPa, the temperature of 100 degrees C, and the conditions for time amount 120 seconds, heat curing was carried out for 40 minutes at 150 degrees C after that, and the laminating of the layered product by which optical waveguide 50 and the resin filler layer 51 were formed on the substrate 21 was carried out.
[0224] (5) Next, print soldering paste to the opening 47 for solder bump formation formed in the solder resist layer 34. Furthermore, while mounting a photo detector 38 and a light emitting device 39 by attaching performing alignment of light sensing portion 38a of a photo detector 38 and a light emitting device 39, and light-emitting part 39a, and carrying out a reflow at 200 degrees C The solder bump 37 was formed in the opening 47 for solder bump formation, and it obtained with the substrate for IC chip mounting (refer to drawing 9 (b)). In addition, as a photo detector 38, what consists of InGaAsP was used as a light emitting device 39 using what consists of InGaAs. In addition, the optical path for lightwave signal transmission will be constituted from a substrate for IC chip mounting manufactured by this example by a resin constituent and an opening, and the conductor layer of these perimeters.
[0225] (Example 2) In the process of (18) of an example 1, it replaced with the resin constituent containing an epoxy resin, and the substrate for IC chip mounting was obtained like the example 1 except having used the resin constituent containing polyolefine. In addition, the optical path for lightwave signal transmission will be constituted from a substrate for IC chip mounting manufactured by this example by a resin constituent and an opening, and the conductor layer of these perimeters.
[0226] (Example 3) The substrate for IC chip mounting was obtained like the example 1 except having not performed the process of (18) of an example 1, i.e., the process which forms resin constituent layer 42a. In addition, the optical path for lightwave signal transmission will be constituted from a substrate for IC chip mounting manufactured by this example by an opening and the conductor layer of the perimeter.
[0227] (Example 4) In (15) of an example 1, and the process of (16), the substrate for IC chip mounting was obtained like the example 1 on the wall surface of opening except having not formed a conductor layer. In addition, the optical path for lightwave signal transmission will be constituted from a substrate for IC chip mounting manufactured by this example by a resin constituent and the opening.
[0228] (Example 5) In (15) of an example 1, and the process of (16), a conductor layer was not formed in the wall surface of opening, but in the process of (18), it replaced with the resin constituent containing an epoxy resin, and the substrate for IC chip mounting was obtained like the example 1 except having used the resin constituent containing polyolefine. In addition, the optical path for lightwave signal transmission will be constituted from a substrate for IC chip mounting manufactured by this example by a resin constituent and the opening.
[0229] (Example 6) In (15) of an example 1, and the process of (16), a conductor layer was not formed in the wall surface of opening, but the substrate for IC chip mounting was obtained like the example 1 except having not performed the process of (18), i.e., the process which forms resin constituent layer 42a. In addition, the optical path for lightwave signal transmission will be constituted from a substrate for IC chip mounting manufactured by this example by the opening.
[0230] (Example 7)
(1) Copper clad laminate which 18-micrometer copper foil 128 laminates to both sides of the

insulating substrate 121 which consists of a glass epoxy resin with a thickness of 0.8mm or BT (bismaleimide triazine) resin was used as the start ingredient (refer to drawing 10 (a)). first, the thing which drill drilling of this copper clad laminate is carried out, and nonelectrolytic plating processing is performed, and is etched in the shape of a pattern -- both sides of a substrate 121 -- a conductor -- the circuit 124 and the through hole 129 were formed.

[0231] (2) Wash in cold water the substrate in which the circuit 124 was formed. a through hole 129 and a conductor -- NaOH (10 g/l), NaClO2 after drying (40 g/l), Melanism processing the water solution containing Na3PO4 (6 g/l) -- melanism -- it considers as a bath (oxidation bath) -- and the conductor which performs reduction processing which makes a reduction bath NaOH (10 g/l) and the water solution containing NaBH4 (6 g/l), and includes a through hole 129 -- the roughening side (not shown) was formed in the front face of a circuit 124.

[0232] (3) Next, the optical waveguide 150 which uses the following approaches for the position on the front face of a substrate, and has an optical-path conversion mirror was formed (refer to drawing 10 (b)). That is, beforehand, the optical waveguide (micro parts company make : 20 micrometers in width of face of 1mm, thickness) of the shape of a film which consists of PMMA by which the tip formed 45-degree optical-path conversion mirror in the end using the diamond saw which is 90 degrees of V types was stuck so that the side face of the other end by the side of optical conversion mirror agenesis and the side face of a substrate might gather. In addition, attachment of optical waveguide 150 applies to 10 micrometers in thickness the adhesives which become an adhesion side with the substrate of this optical waveguide from thermosetting resin, and was performed after sticking by pressure by making it harden at 60 degrees C for 1 hour. In addition, in this example, although hardened on the conditions of 60 degrees C / 1 hour, step hardening may be performed depending on the case. It is because it is hard to generate stress by optical waveguide at the time of attachment.

[0233] (4) the following approach after preparing the resin filler indicated to B of an example 1 -- after preparation -- less than 24 hours -- the conductor of one side of the inside of a through hole 129, and a substrate 121 -- the circuit agenesis section, the optical waveguide agenesis section, and a conductor -- the layer of resin filler 130' was formed in the rim section of a circuit 124. That is, after pushing in a resin filler in a through hole using a squeegee, it was made to dry on 100 degrees C and the conditions for 20 minutes first. next, a conductor -- the conductor with which the part equivalent to the circuit agenesis section lays on a substrate the mask which carried out opening, and serves as a crevice using the squeegee -- the circuit agenesis section was also filled up with the resin filler, and the layer of resin filler 130' was formed by making it dry on 100 degrees C and the conditions for 20 minutes (refer to drawing 10 (c)).

[0234] (5) the belt sander [one side / which finished processing of the above (4) / of a substrate] polish using the belt abrasive paper (Sankyo Rikagaku make) of **600 -- a conductor -- it ground so that resin filler 130' might remain neither in the front face of a circuit 124, nor the land front face of a through hole 129, and subsequently buffing for removing the blemish by the above-mentioned belt sander polish was performed. Such a series of polishes were similarly performed about the field of another side of a substrate. Subsequently, by 100 degrees C, it performed at 150 degrees C for 1 hour for 3 hours, 120 degrees C performed heat-treatment of 7 hours at 180 degrees C for 1 hour, and the resin filler layer 130 was formed.

[0235] thus, a through hole 129 and a conductor -- the surface section of the resin filler 130 formed in the circuit agenesis section, and a conductor -- the front face of a circuit 124 -- flattening -- carrying out -- the resin filler 130 and a conductor -- the insulating substrate which the side face of a circuit 124 stuck firmly through the roughening side (not shown), and the internal surface and the resin filler 130 of a through hole 129 stuck firmly through the roughening side (not shown) was obtained (refer to drawing 10 (d)). this process -- the front face of the resin filler layer 130, and a conductor -- the front face of a circuit 124 and the front face of optical waveguide 150 turn into the same flat surface.

[0236] (6) software etching after rinsing and carrying out acid cleaning of the above-mentioned substrate -- carrying out -- subsequently -- an etching reagent -- both sides of a substrate -- a spray -- spraying -- a conductor -- etching the front face of a circuit 124, the land front face

of a through hole 129, and a wall -- a conductor -- the roughening side (not shown) was formed in all the front faces of a circuit 124. As an etching reagent, the etching reagent (the product made from MEKKU, MEKKU dirty bond) containing the imidazole copper (II) complex 10 weight section, the glycolic-acid 7 weight section, and the potassium chloride 5 weight section was used.

[0237] (7) Next, the somewhat larger resin film than the substrate produced above (1) was laid on the substrate, and after carrying out temporary sticking by pressure and judging on pressure 0.4MPa, the temperature of 80 degrees C, and the conditions for sticking-by-pressure time amount 10 seconds, the resin insulating layer 122 between layers was formed by sticking using vacuum laminator equipment by the approach of further the following (refer to drawing 10 (e)). That is, on the substrate, actual sticking by pressure was carried out on the degree of vacuum of 65Pa, pressure 0.4MPa, the temperature of 80 degrees C, and the conditions for time amount 60 seconds, and heat curing of the resin film was carried out for 30 minutes at 170 degrees C after that. In addition, the above-mentioned resin film was produced like A of an example 1.

[0238] (8) Next, the opening 126 for the Bahia halls with a diameter of 80 micrometers was formed in the resin insulating layer 122 between layers by CO2 gas laser with a wavelength of 10.4 micrometers through the mask with which the through tube with a thickness of 1.2mm was formed on the resin insulating layer 122 between layers on the beam diameter of 4.0mm, the Top Hat mode, 8.0 microseconds of pulse width, the path of 1.0mm of the through tube of a mask, and the conditions of one shot (refer to drawing 11 (a)).

[0239] (9) The roughening side (not shown) was formed in the front face containing the internal surface of the opening 126 for the Bahia halls by immersing the substrate in which the opening 126 for the Bahia halls was formed, for 10 minutes in the 80-degree C solution containing the permanganic acid of 60 g/l, and carrying out dissolution removal of the epoxy resin particle which exists in the front face of the resin insulating layer 122 between layers.

[0240] (10) Next, the substrate which finished the above-mentioned processing was washed in cold water after being immersed in the neutralization solution (product made from SHIPUREI). Furthermore, the catalyst nucleus was made for the front face of this substrate that carried out the surface roughening process (a roughening depth of 3 micrometers) to adhere to the front face (for the internal surface of the opening 126 for the Bahia halls to be included) of the resin insulating layer 122 between layers by giving a palladium catalyst (not shown). That is, the above-mentioned substrate was immersed into the catalytic liquid containing a palladium chloride (PdCl2) and a stannous chloride (SnCl2), and the catalyst was given by depositing a palladium metal.

[0241] (11) Next, into the non-electrolytic copper plating water solution of the following presentations, the substrate was immersed and the thin film conductor layer (non-electrolytic copper plating film) 132 with a thickness of 0.6-3.0 micrometers was formed on the front face (the internal surface of the opening 126 for the Bahia halls is included) of the resin insulating layer 122 between layers (refer to drawing 11 (b)).

[Nonelectrolytic plating water solution]

NiSO4 0.003 mol/l tartaric acid 0.200 mol/l copper sulfate 0.030 mol/lHCHO 0.050 mol/lNaOH 0.100 mol/lalpha and alpha'-bipyridyl 100 mg/l polyethylene glycol (PEG) 0.10 g/l [nonelectrolytic plating conditions]

It is 40 minutes [0242] by whenever [30-degree C solution temperature]. (12) Next, the plating resist 123 with a thickness of 20 micrometers was formed by sticking a commercial photosensitive dry film on the substrate with which the thin film conductor layer (non-electrolytic copper plating film) 132 was formed, laying a mask, exposing by 100 mJ/cm2, and carrying out a development in a sodium-carbonate water solution 0.8% (refer to drawing 11 (c)).

[0243] (13) Subsequently, 50-degree C water washed the substrate and it degreased, with 25-degree C water, after washing with the sulfuric acid further after rinsing, electrolysis plating was performed on condition that the following, and the electrolytic copper plating film 133 with a thickness of 20 micrometers was formed in the plating-resist 123 agenesis section (refer to drawing 11 (d)).

[Electrolysis plating liquid]

Sulfuric acid 2.24 mol/l copper sulfate 0.26 mol/l additive 19.5 ml/l (made in ATOTEKKU Japan, KAPARASHIDO HL)
[Electrolysis plating conditions]
Current density 1 A/dm 2 hours 65 Part temperature 22**2 ** [0244] (14) -- a conductor with a thickness of 18 micrometers which carries out etching processing of the thin film conductor layer under the plating resist 123 with the mixed liquor of a sulfuric acid and a hydrogen peroxide, carries out dissolution removal and consists of a thin film conductor layer (non-electrolytic copper plating film) 132 and electrolytic copper plating film 133 further after carrying out exfoliation removal of the plating resist 123 by NaOH 5% -- the circuit 125 (the Bahia hall 127 is included) was formed (refer to drawing 12 (a)).
[0245] A roughening side (not shown) is formed in the front face of a circuit 125. (15) -- the still more nearly same etching reagent as the etching reagent used at the process of the above (6) -- using -- a conductor -- subsequently The above (6) It has the opening 126 for the Bahia halls like the process of - (8), and laminating formation of the resin insulating layer 122 between layers by which the roughening side (not shown) was formed in the front face was carried out (refer to drawing 1212 (b)). Then, the opening 146 with a diameter of 250 micrometers was formed in the location which counters the optical waveguide 150 of the resin insulating layer 122 between layers using carbon dioxide gas laser through the mask with which the through tube with a thickness of 1.2mm was formed, and DESUMIA processing was further performed to the wall surface of opening 146 (refer to drawing 12 (c)).
[0246] (16) Next, give a catalyst to the front face of the resin insulating layer 122 between layers by the approach used at the process of the above (10), and the same approach. Furthermore, into the nonelectrolytic plating liquid used at the process of the above (11), and the same non-electrolytic copper plating water solution, the substrate was immersed and the thin film conductor layer (non-electrolytic copper plating film) 132 was formed on the front face (the internal surface of the opening 126 for the Bahia halls is included) of the resin insulating layer 122 between layers (refer to drawing 13 (a)). In addition, the mask is formed in the wall surface of opening formed at the above-mentioned process, and a catalyst was not given.
[0247] (17) Next, plating resist 123 was formed by the approach used at the process of the above (12), and the same approach, and the electrolytic copper plating film 133 with a thickness of 20 micrometers was further formed in the plating-resist 123 agenesis section by the approach used at the process of the above (13), and the same approach (refer to drawing 13 (b)).
[0248] (18) next, the approach used at the process of the above (14) and the same approach -- exfoliation of plating resist 123, and removal of the thin film conductor layer under plating resist 123 -- carrying out -- a conductor -- the circuit 125 (the Bahia hall 127 is included) was formed. furthermore, the approach used at the process of the above (2) and the same approach -- oxidation reduction processing -- carrying out -- a conductor -- the front face of a circuit 125 was made into the roughening side (not shown) (refer to drawing 13 (c)).
[0249] (19) Next, it was filled up with the resin constituent which contains an epoxy resin in opening 146 using a squeegee, and after making it dry, flattening of the surface was carried out by buffing. Furthermore, hardening processing was performed and resin constituent layer 142a was formed (refer to drawing 14 (a)).
[0250] (20) Next, made it dissolve so that it may become 60% of the weight of concentration to diethylene-glycol wood ether (DMDG). The oligomer (molecular weight: 4000) 46.67 weight section of the photosensitive grant which acrylic-ized 50% of epoxy groups of a cresol novolak mold epoxy resin (Nippon Kayaku Co., Ltd. make), 80% of the weight of the bisphenol A mold epoxy resin (oil-ized shell company make --) dissolved in the methyl ethyl ketone trade name: -- the Epicoat 1001 15.0 weight section and an imidazole curing agent (Shikoku -- formation -- shrine make --) trade name: -- 2 organic-functions acrylic monomer (the Nippon Kayaku Co., Ltd. make --) which are the 2E4 MZ-CN1.6 weight section and a photosensitive monomer trade name: -- the R604 4.5 weight section -- the same -- a multiple-valued acrylic monomer (the Kyoei Kagaku K.K. make --) trade name: -- the DPE6A1.5 weight section and a dispersed system defoaming agent (the Sannopuko make --) Stir the S-65 0.71 weight section for a container, mix, and a mixed constituent is prepared. The solder resist constituent which adjusted

viscosity to 2.0 Pa-s at 25 degrees C was obtained by adding the benzophenone (Kanto chemistry company make) 2.0 weight section and the Michler's-ketone (Kanto chemistry company make) 0.2 weight section as a photosensitizer as a photopolymerization initiator to this mixed constituent. In addition, in the case of 60min-1 (rpm), in the case of rotor No.4 and 6min-1 (rpm), measurement of viscosity was based on rotor No.3 by the Brookfield viscometer (the Tokyo Keiki Co., Ltd. make, DVL-B mold).

[0251] (21) Next, the above-mentioned solder resist constituent was applied by the thickness of 30 micrometers, for 20 minutes was performed at 70 degrees C, desiccation processing was performed to both sides of the substrate in which resin constituent layer 142a was formed, the condition for 30 minutes at 70 degrees C, and layer 134' of a solder REJISU constituent was formed in them. (Refer to drawing 14 (b)) .

[0252] (22) Subsequently, stick the photo mask with a thickness of 5mm with which the pattern of opening for solder bump formation and opening for optical paths was drawn to layer 134' of the solder resist constituent by the side of IC chip mounting, and they are 1000 mJ/cm2. It exposed by ultraviolet rays, the development was carried out with the DMTG solution, and opening with a diameter of 200 micrometers was formed. Furthermore, it carries out at 120 degrees C for 1 hour for 1 hour, heat-treats [80 degrees C / 1 hour and 100 degrees C] on the conditions of 3 hours by 150 degrees C, respectively, the layer of a solder resist constituent is stiffened, it has the opening 147 for solder bump formation, and opening 142b for optical paths, and the solder resist layer 134 the thickness of whose is 20 micrometers was formed (refer to drawing 15 (a)).

[0253] (23) Next, the substrate in which the solder resist layer 134 was formed was immersed in the non-electrolyzed nickel-plating liquid of pH=4.5 containing a nickel chloride (2.3x10-1 mol/l), sodium hypophosphite (2.8x10-1 mol/l), and a sodium citrate (1.6x10-1 mol/l) for 20 minutes, and the nickel-plating layer with a thickness of 5 micrometers was formed in the opening 147 for solder bump formation. Furthermore, the substrate was immersed in the non-electrolyzed gilding liquid containing a gold cyanide potassium (7.6x10-3 mol/l), an ammonium chloride (1.9x10 to 1 mol/l.), a sodium citrate (1.2x10-1 mol/l), and sodium hypophosphite (1.7x10-1 mol/l) for 7.5 minutes on 80-degree C conditions, the gilding layer with a thickness of 0.03 micrometers was formed on the nickel-plating layer, and it considered as the solder pad 136.

[0254] (24) Next, print soldering paste to the opening 147 for solder bump formation formed in the solder resist layer 134. Furthermore, while mounting a photo detector 138 and a light emitting device 139 by attaching performing alignment of light sensing portion 138a of a photo detector 138 and a light emitting device 139, and light-emitting part 139a, and carrying out a reflow at 200 degrees C The solder bump 137 was formed in the opening 147 for solder bump formation, and it obtained with the substrate for IC chip mounting (refer to drawing 15 (b)). In addition, as a photo detector 138, what consists of InGaAsP was used as a light emitting device 139 using what consists of InGaAs. In addition, the optical path for lightwave signal transmission will be constituted from a substrate for IC chip mounting manufactured by this example by a resin constituent and an opening, and the conductor layer of these perimeters.

[0255] (Example 8) In the process of (3) of an example 7, by sticking film-like optical waveguide, it replaced with the approach of forming optical waveguide, and the substrate for IC chip mounting was obtained like the example 7 except having formed optical waveguide directly on the substrate using the following approaches. That is, after applying the resin constituent containing PMMA resin to the position on a substrate and drying it, flattening of the surface was carried out by buffing, 45-degree optical-path conversion mirror was further formed in the end after hardening processing using the diamond saw whose tip is 90 degrees of V types, and optical waveguide was formed.

[0256] (Example of reference)

(1) The same process as (1) - (19) of an example 7 was performed first, and the multilayer-interconnection plate with which optical waveguide and opening for lightwave signal transmission were formed was produced. Next, the photo detector and the light emitting device were attached in the edge of opening for lightwave signal transmission filled up with the resin constituent, performing alignment. In addition, as a photo detector, what consists of InGaAsP was used as a

light emitting device using what consists of InGaAs. moreover, a photo detector and the connection terminal of a light emitting device, and the conductor of a multilayer-interconnection plate -- connection with a circuit was made with electroconductive glue.
[0257] (2) next, the approach used at the process of (7) - (14) of an example 7 on the multilayer-interconnection plate which attached the photo detector and the light emitting device and the same approach -- the resin insulating layer between layers, and a conductor -- the circuit was formed. Here, that by which opening was beforehand prepared in the part equivalent to a photo detector and a light emitting device as a resin film was used. furthermore, the thing for which the approach used at the process of (16) - (24) of an example 7 and the same approach are performed -- a conductor -- formation of a circuit and a solder resist layer was performed. here -- the process of the above (19) -- not carrying out -- moreover, a conductor -- the circuit was formed so that it might connect with an optical element. The substrate for IC chip mounting with which the optical element (a photo detector and light emitting device) was mounted in the interior was manufactured using such an approach.
[0258] By the approach shown in examples 1-8 and the example of reference, it manufactured 100 pieces at a time the substrate for IC chip mounting, respectively, the cutter cut these substrates for IC chip mounting so that it might pass along optical waveguide and the optical path for lightwave signal transmission, and the cross section was observed. Consequently, also in which substrate for IC chip mounting, optical waveguide and the optical path for lightwave signal transmission which connects optical waveguide and an optical element were secured.
[0259] Moreover, it manufactures 100 pieces at a time the substrate for IC chip mounting, respectively by the approach shown in examples 1 and 7 and the example of reference. After mounting IC chip about these substrates for IC chip mounting, The detector was attached in the edge of the optical waveguide of the side which outputs a lightwave signal, and after making a lightwave signal calculate with delivery and IC chip after that through the optical waveguide of the side which a lightwave signal inputs, while the detector detected the lightwave signal, connection loss with a photo detector and a light emitting device, and the optical path for lightwave signal transmission was measured.
[0260] Consequently, among 100 pieces, with seven substrates for IC chip mounting, a desired lightwave signal could not be detected but what has large connection loss was discovered at the substrate for IC chip mounting manufactured by the approach shown in five pieces and an example 7 among 100 pieces with the substrate for IC chip mounting manufactured by the approach shown in the example 1. Moreover, in the substrate for IC chip mounting manufactured by the approach shown in the example of reference, among 100 pieces, a desired lightwave signal could not be detected but what has large connection loss was discovered with 40 substrates for IC chip mounting. the substrate for IC chip mounting manufactured by the approach shown in the example of reference -- the number of a faulty connection's products -- ** -- the conductor after many one mounts an optical element by the approach shown in the example of reference -- it was the process which forms a circuit, the resin insulating layer between layers, etc., and heat treatment etc. needed to perform, a location gap of an optical element occurred at the time of this heat treatment, and that to which a faulty connection happened was presumed.
[0261] In addition, although there was a product which the faulty connection by location gap of an optical element has generated, since the surface mount of the optical element was carried out, such a faulty connection was cancelable also in the substrate for IC chip mounting manufactured by the approach shown in the examples 1 and 7, by exchanging only an optical element.
[0262] Moreover, it sets to the substrate for IC chip mounting manufactured by the approach shown in examples 1 and 7. In the substrate for IC chip mounting manufactured by the approach which formed the micro lens in the edge of the optical path for lightwave signal transmission through the glue line, and was similarly shown in examples 1 and 7 It is the interior of the optical path for lightwave signal transmission, and the micro lens was formed by using a dispenser and dropping acrylic resin on a resin constituent, (refer to drawing 2 R> 2 and drawing 16). And although connection loss of the lightwave signal of the substrate for IC chip mounting in which these micro lenses were formed was measured like the above-mentioned approach, compared

with the substrate for IC chip mounting manufactured by the approach which all showed to examples 1 and 7, a desired lightwave signal could not be detected but the connection loss of number of the large substrates for IC chip mounting had decreased.

[0263]

[Effect of the Invention] Since the optical path for lightwave signal transmission which connects an optical element and the above-mentioned optical waveguide is arranged while optical waveguide is formed in the interior of this substrate for IC chip mounting as mentioned above, the substrate for IC chip mounting of this invention can transmit the I/O signal of the above-mentioned optical element through the above-mentioned optical waveguide and the above-mentioned optical path for lightwave signal transmission. Moreover, when IC chip is mounted in this substrate, the distance of IC chip and an optical element is short, and it excels in the dependability of electrical signal transmission. Moreover, in the substrate for IC chip mounting of this invention which mounted IC chip, since electronic parts and an optical element required for optical communication can be unified, it can contribute to the miniaturization of the terminal equipment for optical communication.

[0264] Moreover, in the substrate for IC chip mounting of this invention, when the location gap which originates in heat treatment at the time of manufacture when the surface mount of the optical element is carried out does not occur, in addition un-arranging occurs in the optical element of 1, it is [that what is necessary is to exchange only the optical element] economically advantageous.

[0265] while forming optical waveguide in the interior of the substrate for IC chip mounting by the manufacture approach of the substrate for IC chip mounting of the first and the second this invention -- a conductor -- opening which was open for free passage in the circuit layered product and the solder resist layer is formed. When the substrate for IC chip mounting which this opening that was open for free passage could play a role of an optical path for lightwave signal transmission, therefore was manufactured by the manufacture approach of the substrate for IC chip mounting of the first and the second this invention mounts an optical element, it can transmit a lightwave signal suitably through the optical path for lightwave signal transmission between this optical element and optical waveguide.

[Translation done.]

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the sectional view showing typically 1 operation gestalt of the substrate for IC chip mounting of this invention.
[Drawing 2] It is the sectional view showing typically 1 another operation gestalt of the substrate for IC chip mounting of this invention.
[Drawing 3] It is the sectional view showing typically a part of manufacture approach of the substrate for IC chip mounting of the first this invention.
[Drawing 4] It is the sectional view showing typically a part of manufacture approach of the substrate for IC chip mounting of the first this invention.
[Drawing 5] It is the sectional view showing typically a part of manufacture approach of the substrate for IC chip mounting of the first this invention.
[Drawing 6] It is the sectional view showing typically a part of manufacture approach of the substrate for IC chip mounting of the first this invention.
[Drawing 7] It is the sectional view showing typically a part of manufacture approach of the substrate for IC chip mounting of the first this invention.
[Drawing 8] It is the sectional view showing typically a part of manufacture approach of the substrate for IC chip mounting of the first this invention.
[Drawing 9] It is the sectional view showing typically a part of manufacture approach of the substrate for IC chip mounting of the first this invention.
[Drawing 10] It is the sectional view showing typically a part of manufacture approach of the substrate for IC chip mounting of the second this invention.
[Drawing 11] It is the sectional view showing typically a part of manufacture approach of the substrate for IC chip mounting of the second this invention.
[Drawing 12] It is the sectional view showing typically a part of manufacture approach of the substrate for IC chip mounting of the second this invention.
[Drawing 13] It is the sectional view showing typically a part of manufacture approach of the substrate for IC chip mounting of the second this invention.
[Drawing 14] It is the sectional view showing typically a part of manufacture approach of the substrate for IC chip mounting of the second this invention.
[Drawing 15] It is the sectional view showing typically a part of manufacture approach of the substrate for IC chip mounting of the second this invention.
[Drawing 16] It is the sectional view showing typically 1 another operation gestalt of the substrate for IC chip mounting of this invention.
[Description of Notations]
20,120,220,320 Substrate for IC chip mounting
21,121,221,321 Substrate
22,122,222,322 Resin insulating layer between layers
24,124,224,324 a conductor -- circuit
27,127,227,327 Bahia hall
29,129,229,329 Through hole
31 Base Material Layer

34,134,234,334 Solder resist layer
38,138,238,338 Photo detector
39,139,239,339 Light emitting device
240 340 IC chip
242 342 Optical path for lightwave signal transmission
45,245,345 Conductor layer
50,150,250,350 Optical waveguide

[Translation done.]